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Comparative Structure and Efficiency of Part-time Smallholder Farming Systems in Antigua

by

Charlesworth C.M. Tabor

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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Abstract

Part-time farming is a prominent feature of the structure of agriculture in Antigua, however, the phenomenon has never been the subject of any enquiry. This Study was undertaken to determine the extent of part-time farming, to compare the efficiency of resource use of part-time and full-time farms, to compare socio-economic characteristics of part-time and full-time farmers and to draw policy implications from the data which could improve the performance of Antiguan small farmers.

A Cobb-Douglas production function was used to determine resource productivity. The data for the analysis was derived from a sample of sixty farms randomly selected from a frame of all the farmers on government owned land.

In the sample of sixty farmers surveyed 53.3% were part-time and 46.6% full-time operators. Both groups were inefficient in their use of resources. In both cases the inefficiency was similarly expressed by an underutilization of land and overutilization of labour and capital. However, full-time farmers were closer to optimum resource allocation with respect to land and labour.

The differences between the two farm groups were small. The mean age of part-time operators was 56.9 years compared to 55.5 years for full-time operators. The mean farm size and occupancy were 3.19 acres and 12.6 years respectively for part-time operators, and 4.75 acres and 13.6 years respectively for full-time operators. All of the farmers in

both groups engaged in crop enterprises, with specialization in vegetable production being the norm. Livestock enterprises on the other hand, were engaged in by 34.4% of part-time compared to 35.7% of full-time farms.

To improve the performance of small farmers in achieving the national objectives of agricultural food self-sufficiency and the alleviation of rural poverty; policies in the areas of land use, credit and capital, labour and production systems are proposed. These included farm enlargement, the use of more labour intensive technology, better water management practises and the introduction of more livestock into the farming systems.

Acknowledgements

In an undertaking of this nature one is usually indebted to a number of individuals.

I would like to express sincere gratitude to my supervisor, Dr. Peter Apedaile, for his guidance, support and advice. I would also like to thank the Fund for the Support of International Development Activities (FSIDA), which provided the funds that made the field survey possible.

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I. Introduction

A. Purpose

The purpose of this research is to provide insight into the characteristics and efficiency of resource use and development of part-time farming in Antigua. This information is essential to planning for agricultural and rural development.

B. Objectives

The objectives for this research are:

1. to determine the extent of part-time farming in Antigua;
2. to compare the efficiency of resource use of part-time and full-time farms;
3. to compare socio-economic characteristics of part-time and full-time farms,
4. to draw policy implications from the data which could improve the performance of small farmers in Antigua.

C. Overview of Antiguan Agriculture

Antigua is a small island of 276 square kilometers in the Caribbean archipelago located at 61° 45' west longitude and 17° north laititude (see appendix F). Its dependency, Barbuda, located about 40 kilometers to the north of Antigua, is 158 square kilometers in area. Together they

comprise the State of Antigua and Barbuda.

Agriculture in Barbuda was never a very successful enterprise. The reason for this can be attributed not only to conditions of drought and shallow soil, but also to certain historical and cultural factors.[1] Antigua, being the main area for agricultural production, will be the focus of attention in this research.

The crucial issue facing the agricultural sector in Antigua is how to use the now widespread part-time farming phenomenon as a vehicle for agricultural and rural development. Prime Minister V.C. Bird on 17 May, 1982 in St.John's stressed[2] that his administration was placing emphasis on the agricultural sector to reduce the country's high food import bill and to alleviate rural poverty. These two objectives i.e., agricultural food self-sufficiency and rural income growth are important features of the Antiguan government's agricultural policy. The issue of food self-sufficiency is particularly important if Antigua's heavy dependence on the importation of food is to be lessened. This dependence is highlighted in Appendix G, which shows the share of food imports in total imports between 1969-1981 inclusive.

From the time of settlement by the British in 1632 to the early 1960's agriculture was the mainstay of Antigua's

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[1]Riva Berleant-Schiller, "The failure of Agricultural Development in Post-emancipation Barbuda: A Study of Social and Economic Continuity in a West Indian Community", Boletin de Estudios Latinamericanos y del Caribe, 1978, (25): 21-36.
[2]Caribbean Monthly Bulletin, Vol. 16, Nos. 5-6, May/June, 1982.

economy. Initially, smallholders producing cotton and indigo were the dominant force in the economy. However, with the introduction of sugar cane production in 1674 and the plantation system of farming, the importance of smallholder production was dramatically reduced. From that time, the economic and social fortunes of the country followed those of the sugar industry until the first half of the nineteenth century, after which, a period of decline occurred which had serious consequences on the economy. In response to this development the government took a number of measures to alleviate the problems.

Firstly, alternative crops such as pineapples, coconuts, sisal, limes and cotton were introduced after 1900 to reduce the dependence on sugar. Secondly, important changes were introduced in the system of land tenure. Landless peasants were now able to obtain land through the government's land acquisition and distribution scheme which started in 1916. Added to this, uncultivated estate land was made available to peasants on a rental basis. Thirdly, a new and more efficient sugar factory was erected in 1903 to replace several smaller mills.

These measures went a long way to improve the efficiency and productivity of the agricultural sector, however, an eventual decline in the level of employment and contribution to gross domestic product (GDP) occurred during the 1960's. The position with respect to employment is shown in the fact that, of a gainfully employed labour force of

18,605 in 1946, agriculture employed 7,986 or 42.9 percent; whereas in 1960, of a gainfully employed labour force of 17,478 agriculture employed 5,438 or 31.1 percent.[3] With respect to GDP contribution, agriculure's share declined from 26.5% in 1956[4] to an average of 3.9% between 1961 and 1965.[5] This decline in the agricultural sector both in terms of employment and GDP contribution, was due mainly to the growth of the tourist sector and the increasing number of higher paying (relative to agriculture) job opportunities that became available.

The final blow to the agricultural economy came in 1972 with the collapse of the sugar industry. With this event, the economy of Antigua reverted from a sugar monoculture to a mixed cropping system with smallholders reconstituting the dominant force in agriculture. The smallness of the holdings (averaged at 0.5 hectare per farmer in 1974) plus the availability of better paying job opportunities in the tourist industry have led to a high proportion of part-time farmers in Antigua.

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[3]Vincent A. Richards, "The Role of Agriculture in the Economic Development of Antigua and Barbuda", unpublished, 1982, pp. 3-4.
[4]Carleen O'Loughlin, "Problems in the Economic Development of Antigua", Social and Economic Studies, Vol.10, No. 3, 1961, p. 256.
[5]UN/ECLA, Agricultural Statistics of the Caribbean Countries, August 1976.

D. Organization of the Thesis

This thesis is organized into six chapters. The first sets the stage by outlining the purpose and objectives. In the second chapter the physical and socio-economic characteristics of Antigua are addressed. This descriptive chapter establishes the physical and economic environment in which agriculture is practised. Chapter three gives a review of the literature on the phenomenon of part-time farming. Chapter four deals with the methodology and data analysis. An outline of the sampling procedure is first given. This is then followed with a discussion of production function analysis. In chapter five a presentation of the survey results is given. This involves a comparision of part-time and full-time farms on a number of social, economic and structural dimensions. Chapter six concludes with a summary of the results followed by some implications and recommendations.

II. Natural Environment and Historical Background

A. Agro-climatic Characteristics

Landforms

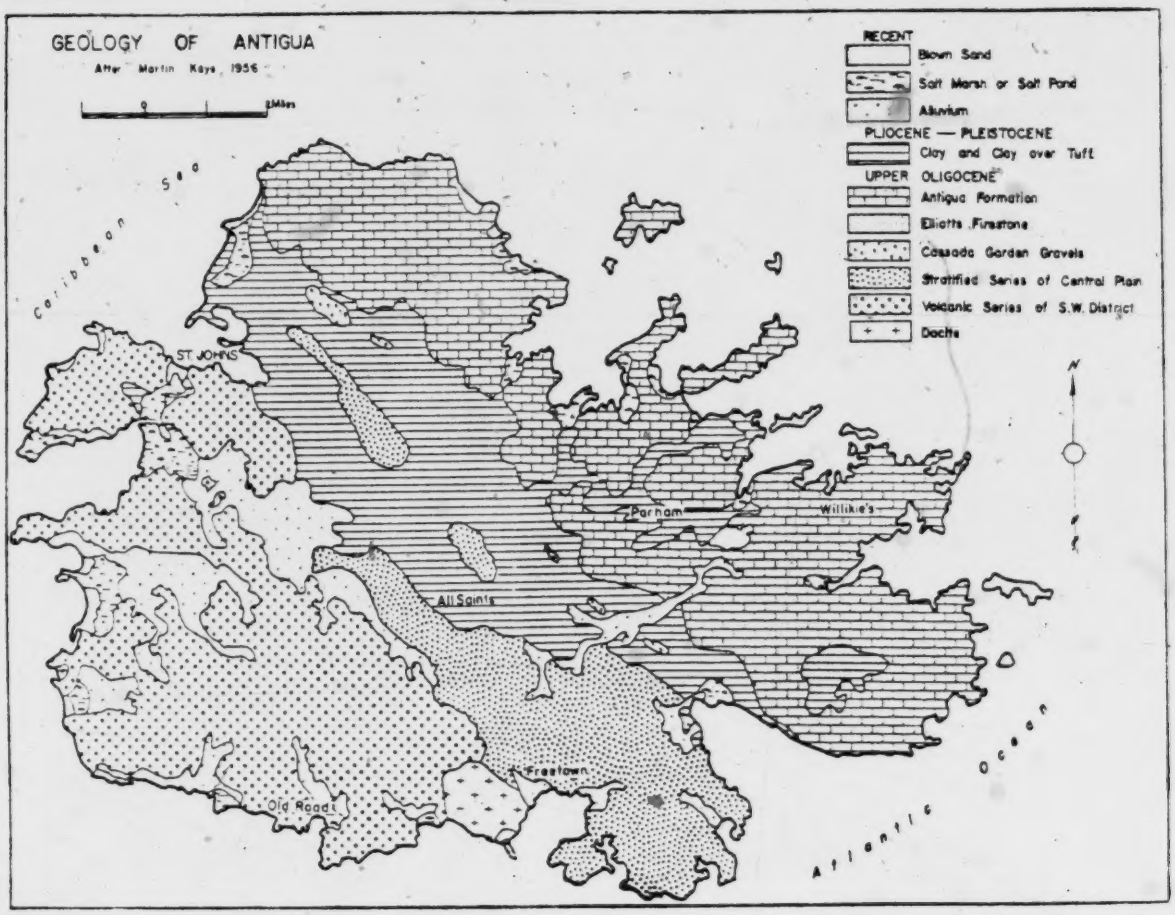
Physiographically, Antigua can be divided into three distinct parts (see fig. II.1). In the southwest section of the island the Igneous Formation that dominates, remains as evidence of the volcanic origin of the island. The highest elevation in this the most mountainous part of the island is Boggy Peak, which rises to about 1,330 feet above sea level.

On the eastern and northeastern section of the island the Limestone Hills dominate. This calcareous formation called the Antigua Formation, consists of rolling, undulating hills which rise to a maximum elevation of just over 400 feet above sea level.

Located between the Igneous Formation in the southwest and the Limestone Hills in the east and northeast is the Central Plain, which runs in a northwest and southeast direction diagonally across the island. The name 'Central Plain' though is perhaps a misnomer since several hills are located in the middle of it, however, the elevation of the land in this area is generally not higher than 100 feet above sea level.

These three main geological features give rise to a variety of soils and consequently agricultural conditions.

Figure II.1 Geological Regions of Antigua.



Source: Soil and Land-Use Surveys, No. 19A, Antigua, Regional Research Centre, U.W.I., St. Augustine, Trinidad, Sept. 1966, p. 6.

Soils

The soils that predominate in Antigua coincide with the geological features outlined in the previous section. In the volcanic southwestern region, the soil is comprised of igneous rocks, ash-beds and agglomerates. The alluvial soils in the valley range from silty clays to loams in texture. In the eastern and northeastern region, the soil is derived from hard limestone or compacted marl. At the foot of the limestone hills the soil is mainly deep black clays, which become shallower as one moves eastward to the coast. The soil of the Central Plain is characterized by heavy brown clays, that consist of water deposited tuffs (particularly the higher elevations), short shales, pebbles and andesites.'

Climate

The climate of the island is tropical (see table II.1), however, because of oceanic influences it is not uncommon for climatic variations to exist over very small distances. The mean minimum and maximum temperatures are 22.9°C and 30.0°C respectively, and an annual range between 20.6°C and 31.2°C.

Periodic drought is a prominent feature of the climate, and this has serious consequences on agricultural production.

'A more detailed account of the soils of Antigua can be found in Soil and Land-use Surveys, No. 19A, Antigua, published by the Regional Research Centre, U.W.I., St.Augustine, Trinidad, Sept. 1966.

Table II.1 Average Monthly Rainfall, Temperature and Relative Humidity, Antigua 1976 - 1981.

Month	Rainfall	Temperature Mean Max	Temperature Mean Min	Relative Humidity
	(cm)	(°C)	(°C)	(%)
Jan	3.42	28.5	20.6	67.3
Feb	4.32	28.6	21.5	67.5
Mar	4.15	28.8	21.2	66.2
Apr	6.94	29.5	22.2	70.5
May	9.17	30.6	24.0	70.8
Jun	4.16	31.0	24.5	70.0
Jul	7.58	30.8	24.3	71.7
Aug	10.71	31.2	24.2	72.0
Sep	11.92	31.0	23.8	72.7
Oct	17.79	31.0	23.8	74.0
Nov	12.66	30.0	23.5	73.0
Dec	8.88	29.0	22.2	73.3
Mean	8.47	30.0	22.9	71.2

Source: Meteorological Office, Antigua.

The annual average precipation is about 112.5 centimeters (see fig. II.2). Half of this occurs during the wet season from August through November. The other half is shared almost equally between the dry season from January through April, and May-June when heavy showers are usually experienced.

Over the time period i.e., from July 1983 to July 1984 upon which this study focussed, the country experienced the worst drought conditions in the last twenty years. In 1983 55 centimeters of rainfall occurred compared to the annual average of 112.5 centimeters. For the first seven months of 1984 a little more than 37.5 centimeters of precipitation occurred. As a result of this unfavourable weather situation farmers experienced one of the most unproductive years in recent memory. The situation became so grave that the government, in August, 1984 resorted to the technique of cloud seeding.

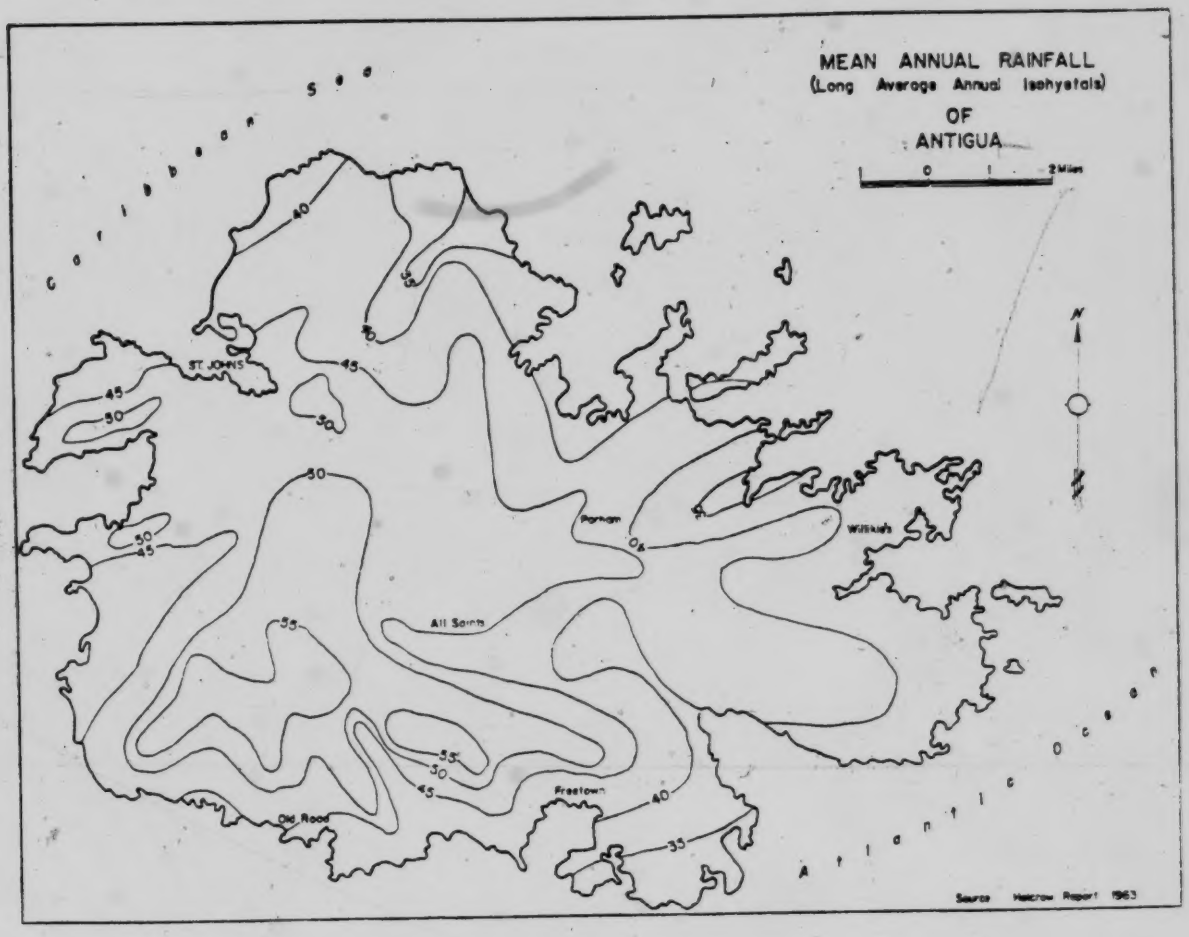
In the following section the history of agriculture will be addressed.

B. The History of Agriculture

Early Smallholders

Antigua was discovered by Christopher Columbus on his second voyage in 1493. However, the island was not successfully settled until 1632 when a group of British emigrants moved to the island from neighbouring St.Kitts.

Figure II.2 Distribution and Mean Annual Rainfall in Inches for Antigua.



Source: Soil and Land-Use Surveys, No. 19A, Antigua, Regional Research Centre, U.W.I., St. Augustine, Trinidad, Sept. 1966, p. 5.

These settlers were small farmers who engaged in the production of cotton and indigo. Later, at about the middle of the Seventeenth century, tobacco replaced cotton and indigo to become the major crop.

The trend towards smallholding was further supported by the British Government through grants of ten acres of land made to soldiers. The effect of this policy was to make smallholders the dominant economic force in the society. This dominance was somewhat short-lived though, because with the introduction of sugar cane production in 1674 and the plantation system of farming, the system of smallholding quickly disappeared.

Because of its gently sloping land, Antigua was ideally suited for the cultivation of sugar. Thus, with the enactment of the Plantation Act in 1673 which made sugar production a profitable enterprise, the agricultural landbase quickly fell under the control of the plantations. In addition, the profitability of the crops grown by smallholders was severely threatened because of the imposition of import duties in Great Britain. This development further contributed to the demise of the system of smallholding. In his article on the pattern of land tenure in Antigua Augelli noted that:

> the introduction of sugar with its costly "works", slaves and animals in the late Seventeenth century quickly eliminated the smallholders and made the estate or plantation the characteristic system of land tenure on the island.[7]

---

[7]John P. Augelli, "Patterns and Problems of Land Tenure in

Plantation Agriculture

The history of agriculture in Antigua is essentially the history of plantation agriculture, because while the early smallholders survived for only forty-two years the plantation dominated the economy for almost three centuries.

Unlike the smallholder who cultivated a small piece of land, the plantation required vast areas in combination with capital and labour. Initially, the labour was provided by Europeans, however, they 'proved incapable of performing the heavy manual tasks involved in cultivating and reaping sugar cane, and in manufacturing sugar...'[8] The tremendous labour requirement that the shift from smallholding to plantation agriculture engendered, was met therefore by the importation of slave labour from Africa. The growth in the slave population was quite rapid. In 1672 there were only 570 slaves. By 1678 the number had increased to 2,172. In 1718, forty years later, the number had grown to about 13,000.[9]

The rapid increase in the slave population and the absence of any unplanted land,[10] indicate how entrenched and

---

[7](cont'd) the Lesser Antilles: Antigua, B.W.I.", Economic Geography 29(4), Oct. 1953, p. 363.
[8]C.Y. Shephard, "Peasant Agriculture in the Leeward and Winward Islands", Tropical Agriculture, Vol. XXIV, Nos. 4-6, 1947.
[9]David B. Gasper "Runaways in Seventeenth-Century Antigua, West Indies", Boletin de Estudios Latinamericanos y del Caribe No. 26, 1979.
[10]Lowell J. Ragatz, The Fall of the Planter Class in the British Caribbean,1763-1833, Octagon Books, Inc., N.Y., 1963, p. 127.

important the plantation had become in a very short period. This period was one of immense prosperity for the planters; it was a veritable "Golden Age". In fact, sugar production almost doubled in the fifty year period between the decades 1711-1720 and 1761-1770, increasing from an annual average of about 4,900 tons in the former to 9,200 tons in the latter.[11] Best attributed this prosperity to excess metropolitan demand and high prices, the introduction of slave labour, cultivation of new land, and the fact that output per slave far exceeded input per slave. In Antigua all the land was under sugar cultivation as early as 1724, therefore, an added factor in this case was the intensive methods of cultivation that were adopted.

The production of cane sugar and its by-products rum and molasses was an undertaking which required vast capital investments, vis-a-vis the crops produced by the former smallholders. As Luffman noted in his description of the average sugar estate in Antigua.

> The buildings on a sugar plantation consist of a wind or cattle mill (sometimes both), a boiling house, a curing house, a house for fermenting the liquor or wash, from which rum is distilled: The great house where the proprietor generally resides, the manager's house, house for the overseers, store-houses for grain, stock houses, and negroe huts.'[12]

In addition to the buildings much equipment was needed at the various stages in the production process. At the

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[11]See Appendix C for sugar production figures.
[12]John Luffman's "Brief Account of Antigua, Letter XX, 1789" as quoted in Elsa V. Goveia, Slave Society in the British Leeward Islands, Yale University Press, 1965, p. 106.

cultivation stage such tools as the fork, cutlass, hoe, mattock and wheel barrow were utilized. In the manufacture of sugar and its by-products the technology involved clarifiers and evaporating boilers, ladlers, skimmers, coolers, pumps, puncheons to store the rum and hogheads to cure and ship the sugar. All this meant that plantation owners had to have access to large amounts of financing.

During the 17th century financing was provided primarily by English merchants, who extended trade credit to the planters until the proceeds from their crop were realized. This type of credit, which usually carried an interest charge of at least 5 per cent, enabled the planter to meet some of his commitments without the necessity of having to have a fund of working capital. In the 18th century the commission system became the dominant mechanism through which capital was obtained. While both systems were concerned with trade, financing, shipping and insurance etc., the primary function of the commission system was the provision of finance capital.

The transition from the merchant system to the commission system evolved as a result of the growing prosperity of the planters, which allowed them to employ agents to look after their interests in London, thus reducing their dependence on independent merchants.

With the coming of the 19th century also came a change in the planters' fortune. The first event which profoundly affected the course of West Indian history was the abolition

of the slave trade in 1807. This was followed in 1834 by the emancipation of the slaves. Although the planters complained that a shortage of labour would ensue following the abolition of the slave trade, this was not the case in Antigua and the other older sugar producing colonies. The problems that these colonies faced at this time were partly rooted in the burden that the huge slave population exerted on their stagnant economies.[13] The reason for the lack of economic growth was due to the erosion of their competitive position. This development resulted from among other things, the addition of the Ceded Islands[14] to the British Empire. With the advantages of more available land and better soil fertility, these islands were able to produce sugar at considerably lower cost. Coupled with this was the passage of the Equalisation Act in 1846, which removed the discriminatory duty levied on foreign sugar entering the United Kingdom. As a consequence, the West Indian sugar planters using wage labour, now found it difficult to compete with foreign slave produced sugar.

Towards the end of the 19th century Antiguan planters experienced a little prosperity as a result of the reduction in and increased efficiency of the sugar mills. However, this prosperity was short-lived due to increasing competition from subsidized European beet sugar, which

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[13]Elsa V. Goveia, Slave Society in the British Leeward Islands, Yale University Press, 1965, p. 126.

[14]These islands included Grenada, the Grenadines, Dominica, St.Vincent and Tobago which were acquired by Britain at the Treaty of Paris in 1763.

caused the price of muscovado to fall from 36 shillings to 13 shillings per hundredweight. The Antiguan and indeed West Indian sugar industry was now on the verge of collapse. The economic malaise was so general and profound that the British Government appointed a Royal Commission in 1897 to investigate the distress in the West Indian sugar colonies. The Commission recommended that attempts be made to diversify the monocultural economy, and that land settlement schemes be undertaken to settle the labouring population on the land as peasants. In light of the fact that sugar would continue to be an important source of national income, the Commission also expressed the need for a more efficient industry.

In response to the Commission's recommendations, efforts at diversification were made after 1900 with the introduction of such crops as pineapples, coconuts, sisal, limes and cotton. The latter proved to be the most successful, reaching 30% of the value of commodity exports by 1958. In 1903 a large, efficient central sugar factory was erected thus establishing a single processing system. This was another measure undertaken to bolster the ailing sugar industry. With respect to the land settlement scheme; this was not inaugurated until 1916 and by 1955 had grown to 27 settlements comprising 17,650 acres of which only 8,500 acres were arable.[15] C.Y. Shephard in his investigation into

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[15]Arlin D. Fentem, Commercial Geography of Antigua, Dept. of Geography, Indiana University, Bloomington, Indiana, 1961, p. 7.

peasant agriculture in the Leeward and Windward Islands noted the following about Antigua:

> Sawcolts settlement was commenced in 1916 when the shortage of shipping had made it desirable to encourage local food production. The lots were to be of not less than one, and not more than three acres in size, and half the original lots were, in fact, on one acre. The lots were not intended to provide full-time occupation for the allottees. Sweet potatoes were to be the principal crop grown both for family consumption and family sale: but these small food plots soon lost their popularity and sugar cane crept in even before the end of the war and soon became a major crop. The experiment at Sawcolts was regarded as a great success.''

It is important to note two points made by Shephard. The first involves the fact that the establishment of full-time farming conditions was never the objective of the scheme. This fact could well be the raison d'etre for the present preponderance of part-time farming in Antigua. The second point concerns the failure in the promotion of local food production. This outcome is not surprising though, given the fact that all the support services of the agricultural sector were geared towards the production of the two plantation crops - sugar and cotton. What is surprising, however, is that this failure to develop a viable peasant sector could be considered a "great success".

Notwithstanding the growth of the peasant sector from 5 settlements in 1916 to 27 in 1955, the smallness of the units and the poor quality of the land meant that the

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''C.Y. Shephard, "Report on Peasant Agriculture in the Leeward and Winward Islands", 1939, as quoted in the Soulbury Commission Report, p. 27.

plantation system remained unchallenged.

With the growth in tourism during the late fifties, the sugar industry and the plantation system of farming began to show signs of decline. As a result, the Antigua Syndicate Estates Ltd.[17] and the Antigua Sugar Factory Ltd. were in a state of insolvency for several years and only survived with financial assistance from the sugar cess funds and the government. In 1966 the government became the major shareholder of the industry and by March 1967 took over full ownership and control from the planter class; when the latter, realizing that "in its present form sugar cannot easily survive modern conditions",[18] readily relinquished their control.

Despite valiant attempts by the government, including the mechanization of harvesting, to keep the plantation system of sugar production intact; the system finally collapsed in 1972 with the closure of the sugar industry. As was mentioned earlier, the emergence of tourism contributed greatly to this outcome. This fact is clearly evident in their respective contributions to GDP. In 1960 the agricultural sector contributed 27% of the total GDP, while tourism contributed 11.86%. Ten years later, the contribution of agriculture declined to just 3%, while the contribution of tourism increased to 16.3%, reaching a peak

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[17]The Antigua Syndicate Estates Ltd. was established in 1943 with the merger of over 30 of the roughly 50 independent estates.

[18]Carleen O'Loughlin, Economic and Political Change in the Leeward and Winward Islands, (New Haven: Yale University Press, 1968), p. 107.

of 21% in 1971.'' Despite a decline in tourism's contribution in recent years, it has continued to be one of the major contributors to GDP (see table II.2).

Small Farm Sector

With the collapse of the sugar industry, small farmers have once again become the main agricultural producers. Table II.3 gives the production of selected crops in the years 1974 and 1978 for both small farms and estates. In both years small farmers have produced a substantially greater proportion of total production than estates. For example, in 1974 small farmers produced over 90% of the cassava, yam and cabbage; over 80% of the corn and pumpkin; over 70% of the tomato; and over 50% of the egg plant. In 1978 they produced over 90% of the corn, sweet potato, cassava and pumpkin; over 60% of the carrot and egg plant; and over 50% of the cabbage, onion and tomato.

Although the small farm sector is responsible for the bulk of agricultural production,[20] it is operating well below its full potential. This situation can be attributed in part to the the large proportion of arable land which remains unoccupied (see table II.4). Despite the government's ownership of these huge tracts of idle, prime agricultural land acquired from the Antigua Syndicate

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''Weir's Agricultural Consulting Services Ltd., Small Farming in the Less Developed Countries of the Commonwealth Caribbean, 1980, p. 234.

[20]See Appendix B for production of selected agricultural commodities between the years 1979 to 1982 inclusive.

Table II.2 GDP and Percentage Composition by Sectors at Constant 1977 Prices, Antigua 1977-1981.

	1977	1978	1979	1980	1981
GDP at Current Market Prices (Mil. E.C.$)	162.5	185.4	229.0	288.2	338.9
Sectoral Distribution (%)					
Agriculture	9.2	9.3	8.3	7.8	7.6
Mining and quarrying	0.8	0.9	0.9	0.9	0.9
Manufacturing	5.2	6.1	7.5	8.9	9.2
Construction	7.5	6.7	6.8	7.3	7.6
Electricity and water	1.3	1.5	1.6	1.4	1.4
Transport and communications	16.4	17.6	18.5	17.5	17.2
Wholesale and retail trade	11.9	12.2	12.5	11.9	11.7
Hotels and restaurants	10.6	11.1	11.9	12.0	11.8
Banking and finance	7.1	6.7	6.2	5.9	5.7
Ownership of dwellings	13.2	12.6	11.8	11.0	10.8
Public administration	16.5	14.6	13.4	15.1	15.6
Other services	0.3	0.7	0.6	0.1	0.5
TOTAL	100.0	100.0	100.0	100.0	100.0

Source: Ministry of Trade, Planning and Tourism Antigua.

Table II.3 Production of Selected Agricultural Products by Small Farmers and Estates, Antigua 1974-1978*.

Products	1974			1978		
	Small Farmers	Estate	Total Quantity	Small Farmers	Estate	Total Quantity
	%	%	1000 kg	%	%	1000 kg
Corn	82.8	19.3	40.1	98.0	2.0	42.5
Sweet Potato	44.2	45.8	148.6	90.2	9.8	186.5
Cassava	93.5	6.5	16.4	96.8	3.2	65.3
Yam	94.7	5.3	62.7	-	1.6	80.3
Tomato	70.2	29.8	62.8	53.7	46.3	295.7
Cabbage	95.0	5.0	14.2	57.7	42.3	35.95
Carrot	27.9	72.1	35.5	69.9	30.1	125.5
Onion	5.8	94.2	62.1	57.0	43.0	27.9
Egg Plant	59.1	40.9	57.9	61.5	38.5	44.9
Pumpkin	88.3	11.7	39.7	93.1	6.9	86.9
Pineapple	N.A.	N.A.	N.A.	18.6	81.4	N.A.

*These are mainly estimates based on Estate sales and land planted in particular crops by small farmers.

Source: Agricultural Extension Services 1974, 1978 - Annual Reports.

Table II.4 Small Farmer Land Use, Antigua 1975*.

District	Total Hectares	Approx. Arable Land	Total Arable Land Occupied	In Cotton	In veg. and Food	Unoccupied Arable
Eastern	1,886.4	685.2	314.7	86.1	228.6	370.5
Southern	2,835.6	1,318.8	290.3	9.2	281.1	1,028.5
Northern	1,878.4	1,047.2	463.2	124.9	338.3	584.0
Total	6,600.4	3,051.2	1,068.2	220.2	848.0	1,983.0

*This was the most recent survey done by the Ministry of Agriculture. An agricultural census was started in November, 1984.

Source: Agricultural Extension Services.

Estates Ltd. in 1967, and also the government's declared agricultural policy of food self-sufficiency, it is difficult to understand why this paradoxical situation should persist. If the goal of agricultural food self-sufficiency is to have any prospect of success; the government will have to make available to small farmers more of the prime agricultural land, and in acreages that will facilitate independent economic activity.

The latter point is of great importance if small farmers are to make a living from farming and young people are to be attracted to it. Moreover, because the Antiguan smallholder has no long established ties of tradition or sentiment to the land which he cultivates,[21] very little incentive is needed to engender a move from agricultural to non-agricultural employment. A UN/ECLA report,[22] indicated that in 1960 60% of the population was rural and 40% urban, but by 1970 the situation was almost reversed with 45% rural and 55% urban. This finding points to a need for providing better incentives to the small farm sector to prevent further decline in the farm population.

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[21] See Woodville K. Marshall, "Notes on Peasant Development in the West Indies since 1838", Social and Economic Studies, Vol. 17, No. 3, Sept. 1968, pp. 252-263.

[22] UN/ECLA, Agricultural Statistics of the Caribbean Countries, August 1976.

C. Farming Systems

In this section the farming systems of Antigua will be discussed. In defining a farming system the Technical Advisory Committee for the Consultative Group on International Agricultural Research stated:

> A farming system is not simply a collection of crops and animals to which one can apply this input or that and expect immediate results. Rather, it is a complicated interwoven mesh of soils, plants, animals, implements, workers, other inputs and environmental influences with the strands held and manipulated by a person called a farmer who, given his preferences and aspirations, attempts to produce output from the inputs and technology available to him. It is the farmer's unique understanding of his immediate environment, both natural and socio-economic, that results in his farming system.[23]

The natural environment, which is one of the factors that influences the types of farming systems that exist in a particular location has been discussed earlier, therefore, the focus here will be on the socio-economic environment.

Farming systems have been classified on the basis of such characteristics as the type of rotation, the intensity of rotation, source of water supply, cropping pattern and animal activities, implements used for cultivation, and the degree of commercialization.[24] Figure II.3 shows the paths

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[23]Technical Advisory Committee for the Consultative Group on International Agricultural Research, "Farming Systems Research at the International Agricultural Research Centers", Agriculture Dept., FAO, Rome, 1978, pp. 8-12 (Restricted) as quoted in Gordon R. Banta, Asian Cropping Systems Research: Micro Economic Evaluation Procedures, Ph.D. Dissertation, University of Alberta, Spring 1980, p. 30.

[24]Hans Ruthenberg, Farming Systems in the Tropics, Clarendon Press, Oxford, 1980, pp. 14-17.

The material on this page has been removed because of the unavailability of copyright permission. The material was a diagram showing the evolutionary development of farming systems in semi-arid climates. It was taken from page 358 of the book "Farming Systems in the Tropics" by Hans Ruthenberg, published by Clarendon Press, Oxford, 1980.

of development that farming systems can take in a country such as Antigua which has a semi-arid climate. It should be pointed out that this schema is valid only in the case of indigenous smallholders, and is not applicable to plantation type farming since the latter is invariably connected with the adoption of a more advanced system of farming.[25]

Because plantation agriculture was introduced into Antigua very early in the country's history, a strong indigenous smallholding system did not develop. As a result, it is difficult to fit the evolution of farming systems in the country into the schema of figure II.3.

The early settlers practised shifting cultivation. Today, the farming system of smallholders is based on permanent upland cultivation. Several features characterize smallholder agriculture in Antigua. The majority of smallholders engage solely in crop production. Mixed animal-crop systems are not widely practised. Mixed cropping involving vegetables and such root crops as sweet potatoes, yams and cassava is the norm. Because farming is rain-fed with a short wet season extending from August to November, most farmers use this period to produce vegetables since the latter require a short growing period. Also, given the small size of farms cultural practices are mainly manual and cropping systems highly intensive. However, despite the smallness in farm size production is oriented primarily to the market rather than to subsistence.

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[25] Ibid., p. 358.

Farm produce is disposed of domestically through higglers and the Central Marketing Corporation (CMC). Internationally, the marketing of farm produce is handled through the CMC. The CMC was established in 1975 when the former government controlled marketing depot became a statutory board. Apart from buying and selling agricultural produce, the corporation also sells seeds and agricultural chemicals. The number of farmers who use the CMC as a marketing outlet is quite small. The low minimum guaranteed prices that are set can perhaps be cited as one of the reasons for this. In addition, farmers must bear the cost of transporting their produce to the CMC, whereas higglers usually buy at the farm gate thus reducing the farmer's marketing costs.

The financial system also impacts on the farming system through the credit policies of lending institutions. Table II.5 shows the number of loans approved by the Antigua and Barbuda Development Bank (ABDB) from 1979 to 1982. Although this number is high compared to loans made by commercial banks, many farmers are unable to meet the loan requirements of the ABDB. The ABDB charges interest of 12% on loans less than $10,000 and 10.5% on loans greater than $10,000, while the commercial banks interest on loans range from 13%-14%. However, the security that creditors must provide to obtain an ABDB loan is similar to that of the commercial banks. In both cases loans must be secured by a mortgage on land and/or buildings.

Table II.5 Summary of the Antigua and Barbuda Development Bank Agricultural Production Credit Loan Programme, for Crops and Livestock 1979-1982.

Year	Crop		Livestock	
	No. of Loans Approved	Value (E.C.$)	No. of Loans Approved	Value (E.C.$)
1979	62	103,997	10	21,600
1980	62	149,510	10	30,870
1981	54	145,650	12	54,500
1982	28	71,000	15	65,000
Total	206	470,157	47	171,970

Source: Antigua and Barbuda Development Bank.

III. A Review of Part-time Farming

A. Extent of Part-time Farming

The practise of part-time farming is not unique to any particular country. As the Wye-College workshop report in 1977 stated:

> Part-time farming is a phenomenon common to the agriculture of all societies no matter what the political creeds, level of economic development or social patterns are.[2]

However, despite the pervasiveness of part-time farming, most of the studies investigating the phenomenon involve the developed industrial countries. It is not surprising that most of the research has come out of the United States, since as early as 1930 information on part-time farming was included in their Census of Agriculture. Since that time an increasing trend in the number of part-time farm operators has been noted. Whereas in 1929 off-farm work was reported by about 30% of farm operators of which 11.5% worked 100 or more days away from the farm (Cavazzani, 1976), in 1978 off-farm work was reported by 55% of farm operators of which 44.4% worked 100 or more days off the farm (U.S. Dept. of Commerce, 1980).

Similar trends are observed in many Western and Eastern European countries, Asia and Canada. For example, in West Germany in 1974, 15% of all farms greater than one hectare

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[2] Wye-College, Part-time Farming: Its Nature and Implications, Wye College, University of London, Seminar Papers, No. 2, 1977.

were operated on a part-time basis (OECD, 1977), compared to 39% in 1980 (Mrohs, 1982). In the United Kingdom the number of part-time farmers increased from 68,000 in 1971 to 80,000 in 1979, or from 23% to 27% respectively of the total farm population (Gasson, 1982).

In Spain, a 1965 agricultural survey which investigated the phenomenon of part-time farming on the basis of income, found that 37.7% of farm incomes were derived from off-farm employment; while a similar survey in 1972 using labour time as the basis of evaluation, found that 48% of the farm population held main jobs off-farm and controlled holdings comprising 23% of the total agricultural landbase (Arnalte, 1982). Because both surveys used different criteria to measure the phenomenon, it cannot be stated definitively that the incidence of part-time farming increased during the 1965-1972 period. However, both surveys underscore the importance of part-time farming in Spain.

In Italy during the period 1930-1961, the percentage of farms classified as part-time rose from 39.3% to 48.8%. In numerical terms this represented an increase in the number of part-time farms by about 450,000. This increase resulted mainly from the conversion of farms from full-time to part-time and not so much from the creation of new part-time farms. By 1970 it was estimated by the Italian Institute of Rural Sociology (INSOR) that 54.5% of all farms operated on a part-time basis (OECD, 1977).

Although the concept of part-time farming does not readily fit into the Marxist framework of collectivized agriculture, the phenomenon nonetheless exists widely in such Eastern European countries as Poland, Yugoslavia, Hungary and Czechoslovakia (Frauendorfer, 1966). Because very few of the studies in these countries have been published in English, it is difficult to provide statistics as evidence of the extent of the phenomenon. Such statistics as are provided derive mainly from papers presented by Eastern European scholars at various international conferences and symposiums. For example, at the Guelph Rural Geography Symposium in 1975 Dyzma Galaj of the Polish Academy of Sciences, noted that in 1960 22.6% of the heads and 28% of the members of peasant families were permanently employed off-farm. In the 1970 Census these percentages increased to 30% and 35% respectively. A brief insight into the situation in Yugoslavia was provided by Professor Stane Krasovec, in his paper presented to the 12th International Conference of Agricultural Economists at Lyon in 1964. Professor Krasovec noted that in 1961 20% of all families obtained their incomes from both agricultural and non-agricultural employment. When agricultural families are considered separately, the percentage of those living on mixed incomes increased to about 40%.

In Japan, part-time farming is almost the rule with nearly 90% of all farm households classified as part-time, and about 75% of farm family income coming from off-farm

sources (Kada, 1982). Krasovec (1965) attributed this high proportion of mixed occupations partly to land reform limitation and partly to the Asiatic practice of identifying holdings with family, such that each family member irrespective of their location and employment, is tied to the holding.

In India, the phenomenon of part-time farming is also widespread, especially since the huge population base makes full-time employment on the land a rather difficult prospect. However, not many studies have been done which deal specifically with part-time farming. Because the problem of rural poverty and unemployment is usually dealt with within the framework of the village, the literature on part-time farming is closely interwoven in and subsumed under the numerous publications on general village development (Frauendorfer, 1966).

In Canada, part-time farming has been an enduring feature of the structure of agriculture. Since 1941 about one-third of census-farm operators have reported some off-farm employment (Bollman, 1982). In 1978 the O.E.C.D. reported that 30.6% of all farm operators were part-time farmers, and they occupied 19.2% of the agricultural landbase. However, given Canada's geographic diversity and the consequent differences in social and economic environments, wide variations exist in the degree and intensity of part-time farming across the country.[2'] For

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[2']J.A. Mage, "The Geography of Part-time Farming - A New Vista for Agricultural Geographers", GeoJournal, Vol. 6, No.

example, in 1981 41% of Alberta's farm operators reported off-farm work. In Newfoundland on the other hand, only 15% of farm operators reported working off-farm.[28]

In Africa, part-time farming was always a part of rural life. However, the phenomenon has not received the same level of attention in the literature as it has in the countries mentioned earlier in this review. The majority of the studies that have been published relate mainly to West Africa and in particular Nigeria. In the case of the latter, the proportion of farm operators reporting off-farm work has increased from 26.3% in 1970 to over 43% in 1980 (Okafor, 1982).

In the case of the Commonwealth Caribbean, there is very little written about part-time farming except for the works of H.H. Beach, Lambros Comitas, Carlisle Pemberton and several surveys on small farming. This dearth of written material is especially ironic since historically a built-in system of part-time farming (minifundia) operated in the region, to provide subsistence for sugar plantation workers during the dead season (Cumper, 1959; Klass, 1961). The underlying objective of this system was to ensure a ready supply of labour for the plantations, since peasant holdings were invariably too small to provide an adequate year-round means of livelihood (Greenfield, 1964; Clarke, 1957; O'Loughlin, 1959; Klass, 1961).

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[27](cont'd) 4, 1982, p. 304.
[28]Statistics Canada 1981 Agricultural Census.

The small-farmer surveys that were undertaken in the Caribbean provide evidence of the prevalence of multiple jobholding. For example, Handler (1965) in his study of workers on small sugar plantations in Barbados, found that 80% of these workers engaged in at least three other income-producing activities. Momsen (1970) found that in a sample of 200 small farmers she interviewed in Barbados, 62% worked off their farms. In Grenada, Brierley (1974) found that 39% of the 292 small farmers he interviewed obtained at least half their income from off-farm employment. Mills (1976) in his survey of 66 smallholders in St.Kitts, found that almost all of them also worked as labourers on the sugar plantations during the 5-month harvest period. In Antigua, a survey undertaken by the Ministry of Agriculture in 1977 of 100 small farmers, found that 48 of the 92 farmers who responded to questions about off-farm employment spent at least half their labour time working in off-farm jobs.

B. Definition of Part-time Farming

In 1936 Salter noted that the "Confusion of part-time farming concepts and definitions has made it impossible to compare results of studies and very difficult to interpret the results of them."[2] The question of definition remains a major problem for researchers up to the present day.

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[2] Leonard A. Salter, "What is Part-time Farming?", Journal of Farm Economics, Vol. 18, No. 1, 1936, p. 191.

Rozman[30] who introduced the terms "part-time farming" and "part-time farmer" in 1930, defined a part-time farmer as a farm operator who worked off-farm two or more months per year. Time devoted to off-farm employment is by far the most common criterion used in definitional formulations of part-time farming. The other major definitional criterion and perhaps the most important in terms of economic analysis, is that of income derived from off-farm sources.[31] However, whether income, time or a combination of both is used to measure occupational involvement, researchers agree that gainful employment should be the point of reference. Opinions differ though regarding the inclusion of such nonwork incomes as dividends, interests and pensions.

Another criterion used to define part-time farming, particularly in census statistics, is income derived from the sale of agricultural products. For example, the 1950 U.S. Census defined a part-time farmer as a farm operator with gross sales in the range $250 to $1,199 inclusive, and who or any of his family worked off-farm for 100 or more days, and whose off-farm family income exceeded gross farm sales. While this definition includes both the farm operator and farm family, it remains a controversial issue today as to whether the operator or the household should be the unit

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[30] D. Rozman, "Part-time Farming in Massuchusetts", Massuchusetts Agricultural Experiment Station, Bulletin No. 266, October, 1930.

[31] Ruth Gasson (ed.), The Place of Part-time Farming in Rural and Regional Development, Centre for European Agricultural Studies, 1977, p. 7.

of analysis. Although using the household rather than the operator as the unit, would make the analysis more complex; most researchers favour the household as the unit of analysis. In support of this position Kada noted that:

> Using the family as the unit seems more appropriate for study in an agricultural and rural development context because it not only is the basic decision-making unit of consumption and expenditure, but also determines the nature of labor and other resource allocations as a whole. Therefore, it seems reasonable that more attention be paid to the family as the unit of focus for part-time farming research and its policy considerations.[32]

Bollman has also argued that from a welfare point of view the household should be the unit of analysis.[33] The merit of this position is however, not always followed in census statistics. For example, the United States and Canada have reverted to the method of using the farm operator as the unit of analysis, while in West Germany the farm operator and/or his wife are used as the unit. In Japan on the other hand, the policy of making the household the unit of analysis is followed completely with the inclusion of all family members in the unit.

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[32]Ryohei Kada, Part-time Family Farming, Center for Academic Publications, Japan, 1980, pp. 15-16.
[33]Stane Krasovec (ed.), Part-time Farmers and their Adjustment to Pluriactivity, Proceedings of the Seminar Ljubljana, 20th-24th June, 1981, pp. 37-38.

C. Part-time Farming and Efficiency of Resource Use

Efficiency can be defined in terms of such partial productivity ratios as output per acre, output per capita and output per dollar of capital. However, efficiency in economics is usually defined in terms of the equalization of marginal value product and cost.

Like the other facets of part-time farming, the literature on efficiency of resource use also contains many divergent opinions. In the extreme negative case, questions are raised about the usefulness of part-time farming and a stigma is attached to the phenomenon. This attitude developed during the 1950's and 1960's particularly in the United States when full-time family farms were promoted.[34] More recently, with the growing awareness of the social significance of the phenomenon, and the fact that it appears to be more than just a transitional phase in the agricultural structure of many countries; the previous attitude of "benign neglect" has given way to a more general acceptance, which has consequently led to more extensive study of the phenomenon.

Even without the benefit of empirical analysis researchers such as Martens and Crown have argued that, the persistent nature of part-time farming can be taken as evidence that a certain amount of efficiency does exist with respect to resource use. In a review of the literature on

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[34]Anthony M. Fuller and J.A. Mage, A Directory of Part-time Farming Studies, Vol.1, University of Guelph, Dept. of Geography, 1977,pp. 5-6.

part-time farming in Canada by Bollman,[35] the question as to whether part-time farming implied inefficient land use or inefficient food production was addressed. Except for the study by Cortez and Winter (1974) of part-time farmers in the Fraser Valley of British Columbia, all of the other studies found that part-time farming did not imply inefficiency in land use or in food production. In a study of part-time farmers in England Gasson[36] found that their intensity of land use was lower than that of full-time farmers, resulting in a Standard Output of £77 per acre and £99 per acre respectively. Generally, it is agreed that part-time farms are more efficient than full-time farms with respect to labour use, while the latter are more efficient with respect to capital and land use. It is also generally agreed that part-time farms tend towards less intensive production and monocultures.[37]

On the basis of these studies the conclusion may be reached that the part-time farming model should be abandoned, since the consensus regarding efficiency favours

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[35]R.D. Bollman, Selected Annotated Bibliography of Research on Part-time Farming in Canada, Working Paper, Economics Branch, Agriculture Canada, Ottawa, 1978.

[36]Ruth Gasson, "Some Economic Characteristics of Part-time Farming in Britain", Journal of Agricultural Economics, Vol. 18, No. 1, January, 1967.

[37]See for example H.J. Bonser, Part-time Farming in the Knoxville City-County Fringe, Tennesee Agricultural Experiment Station, Bulletin No. 270, 1957; W.A. Wayt and T.J. Dix, Adjusting the Commercial Family Farm to Part-time Operation in Southeastern Ohio, Ohio Agricultural Experiment Station, Research Circular No. 97, 1961; James F. Thompson, Part-time Farming and Resource Productivity in Western Kentucky, University of Kentucky Agricultural Experiment Station, Dept. of Agricultural Economics, 1964.

the full-time farming model. However, this course of action might be inappropriate for as Gasson herself noted:

> By their readiness to experiment and prove new techniques under a variety of conditions, the part-time farmers can perform a valuable service to the whole agricultural industry. They bring capital into this industry from elsewhere, some of it being used to preserve old farmhouses and buildings. Also on the credit side must be added the non-material benefits and satisfaction which part-time farm family enjoys. When all these benefits are set against the income foregone through part-time rather than full-time farming, the cost does not seem unduly high.[30]

As is also quite evident in the cases of Hungary and Japan, the part-time farming model has been more effective than the modern farm. In 1980 part-time farms in Hungary occupied 11.5% of total cultivated land and accounted for 34% of gross agricultural production. The average size of these farms were 0.7 hectare.[31] In the Japanese case the 1980 Census of Agriculture showed that full-time farm households accounted for only 10% of the total number of households, occupied 15% of the total farmland and produced 23% of the total agricultural output. Part-time Type 1 farm households (i.e., households in which net farm income equals or exceeds off-farm income) accounted for 20% of the total number of households, occupied 38% of the total farmland and produced 47% of the total agricultural output; while Part-time Type 2 farm households (i.e., households in which total off-farm income exceeds net farm income) accounted for 66% of the

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[30] Gasson, op. cit., p. 121.
[31] Gyorgy Enyedi, "Part-time Farming in Hungary", GeoJournal, Vol. 6, No. 4, 1982, p. 324.

total number of households, occupied 45% of the total farmland and produced 29% of the total agricultural output.[40] Together the part-time farm households accounted for just over 75% of the total agricultural output however, it is the Type 1 farm household that proves to be the effective mechanism in the Japanese agricultural economy.

Even though overall it would appear that part-time farms use resources less efficiently than full-time farms, it would be unwise to conclude from this that part-time farming should be discouraged. The situation in each country has to be assessed on its own merit and not on the basis of generalizations. As indicated by the cases of Japan and Hungary, part-time farming can make an important contribution to the economy.

In many developing countries it is the contribution of part-time farmers that helps to reduce the large food import bill. Although the contribution of part-time farmers to food production in Antigua is not known exactly, since small farming statistics are not categorized separately for both groups of farmers; it is evident from Tables III.1 and V.20 that part-time farmers make a major contribution to agricultural production. As Table III.1 indicates, full-time farms used more than twice the labour time and almost three times the capital used on part-time farms, however, the gross farm output of full-time farms was only slightly

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[40]Ryohei Kada, "Trends and Characteristics of Part-time Farming in Post-war Japan", GeoJournal, Vol. 6, No. 4, 1982, p. 369.

higher than that of part-time farms.

Table III.1 Statistical Properties of Selected Structure Variables for Part-time and Full-time Farmers, Antigua 1984.

	Part-time		Full-time		
	Mean	S. D.	Mean	S. D.	t
Gross Farm Output ($)	1,375.9	1,167.2	2,275.1	4,693.3	-2.62*
Labour (person-days)	111.7	62.5	234.8	90.2	-6.20*
Capital Expenditure ($)	3,443.0	7,925.5	8,888.4	24,613.2	-8.87*
Farm Size (acres)	3.19	2.01	4.75	6.03	-1.38

*Significant at the 5% probability level.

a) Dollars are in Eastern Caribbean Currency ($1.00 E.C. = $0.37 U.S.).

Source: Survey Results.

IV. Research Methodology and Data Analysis

A. Questionnaire and Sampling Procedure

Questionnaire

The questionnaire was the principal data collecting instrument used in the field. It was comprised of ten short sections (see Appendix A) whose objective was to obtain from each small farmer information relating to the farm, farm household, production, cropping system, financing and post-production system.

Familiarity with the island allowed the author to design a questionnaire that was appropriate to the cultural circumstances of the study area. For example, the response rate of a survey method which used a mailed questionnaire would have been extremely low, since the population was not accustomed to this method. Therefore, the interview method was employed. These interviews were always done in the farmer's plot. In cases where a farmer cultivated several plots which were some distance apart, separate visits were arranged to see these.

The questionnaire was pre-tested on six farmers randomly selected from the population. The results of the pre-test necessitated that the questionnaire be modified in one important respect i.e., that Section E dealing with labour disposition on the farm be dropped since it proved too difficult to complete. This difficulty arose because

much detail was required over a twelve-month period, and very few farmers kept records. In the sample of 60 only 2 farmers kept records of their farm business. However, the information required in Section E was as far as possible collected via Section A question 7 and Section C question 8.

Since the format of the questionnaire facilitated completion in the field in that, many of the questions required responses that were very short, the average time it took to complete a questionnaire was 40 minutes. Interviews were conducted Monday through Friday with an average of three per day. The maximum number of questionnaires completed in a day was six, however, there were also several days in which none were completed due to the absence of the respondents from their plots.

Sampling Frame

Initially, the Agricultural Census and/or the membership of the small Farmers Association were considered as possible sampling frames. However, these alternatives proved inappropriate since the last comprehensive Agricultural Census was done in 1961. Another is currently being undertaken, however the results will not be published until 1985. Membership of the Small Farmers Association was also considered, however this was inappropriate since membership was just over one hundred.

A list of names with home address, farm location and farm size of all farmers on government land was obtained

from the Agricultural Extension Division of the Ministry of Agriculture.[41] This list included 1,234 farms ranging in size from 0.1 acre to 120 acres accounting for 60 percent of the number of farms in Antigua.

Sample

The sampling frame was numbered and a sample of sixty was randomly selected. Because one of the objectives of the study was to determine the extent of part-time farming, a self-weighting sampling procedure was adopted. In other words, there was no prior knowledge of a respondent's status i.e., whether part-time or full-time. This status was determined at the beginning of the interview by finding out the number of days the respondent worked off-farm or the percentage of their income derived from farming.[42] Each respondent was placed into either one of the two categories until the sample size was reached. In the sample of sixty 28 subsequently were classified as full-time and 32 as part-time. If any category had contained less than 10 sampling units, the total sample size would have been

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[41]Farmers on privately owned land were not considered since this group is insignificant and it would be difficult if not impossible to obtain a list of them, since the provisions of the Agricultural Smallholdings Act which stipulate among other things; that smallholdings, and contracts between landlord and tenants should be registered, have not been enforced.

[42]A person who obtained more than 50% of their income from farming or worked less than 60 days off-farm would be classified as full-time, while a person who obtained less than 50% of their income from farming or worked more than 60 days but less than 180 days off-farm would be classified as part-time.

increased until a minimum of 10 was obtained, thus the sample size could have ended up being considerably greater than 60.

Another sample of fifteen exclusive of the first was randomly selected to serve as replacements, in the event that a sampling unit in the survey sample could not be located. This was the situation in three cases: two due to death and one where the respondent was out of the country.

The survey was started on 5 July, 1984 and was completed on 14 August, 1984. The farmers were generally co-operative with only one refusing to disclose any information relating to financing. However, most of the respondents were very skeptical at the outset, since they said they were tired of being interviewed and could not perceive any tangible benefits from the exercise. At times therefore, much time had to be used to convince farmers of the importance and necessity of their support.

B. Resource Allocation and Efficiency

Production Function Analysis

To investigate the pattern of resource use and to compare allocative efficiency between part-time and full-time farm operations, an estimate of a production function will be carried out for each of the two groups. The functions will be derived for both groups by using the input-output data for each of the farms within a group as

observations in the regression analysis.

Functional Forms

A production function represents the relationship between the inputs required to produce a particular product and the output of the product. This relationship may be written as:

$$(1) \qquad Q = f(X_1,....X_m,Z_1,....Z_n)$$

where Q is the quantity of output and X and Z represent quantities of variable and fixed inputs respectively. To describe and estimate the relationship that a production process represents, a number of functional forms have been used. One of the most widely used production functions in the early literature was the Cobb-Douglas. This function operated on the assumptions of unitary elasticity of substitution between input factors (homogeneity), and constant elasticity of transformation (homotheticity). These assumptions, in particular that of homogeneity, have restricted the flexibility of the Cobb-Douglas function.

In an effort to overcome the restrictive nature of the Cobb-Douglas function, a number of generalized functional forms have been developed. The first of these, the Constant Elasticity of Substitution (CES) function, was popularized by Arrow *et al.* in 1961. Unlike the Cobb-Douglas function, the CES function does not make the restrictive *a priori*

assumption of unitary elasticity of substitution. Instead, the CES function assumes constant elasticity of substitution. When the CES function assumes unitary elasticity of substitution it becomes similar to the Cobb-Douglas function, and when it assumes zero elasticity of substitution it becomes similar to the Leontief fixed-proportion function.[43]

A functional form which goes even further than the CES function in relaxing the homogeneity assumption, is the Homothetic Isoquant Production function (HIPF).[44] The HIPF postulates only the assumption of homotheticity. The assumption of homogeneity is not maintained since the elasticity of substitution in this functional form is not necessarily constant.

There are many more functional forms and as Denny noted, "the development of functional forms for the technology continues to expand at a rapid pace."[45] Examples of other functional forms include Diewert's generalized Leontief, the generalized quadratic and the transcendental logarithmic function. These three functions are considerably more general and flexible than the functions mentioned

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[43]See C.E. Ferguson, The Neoclassical Theory of Production and Distribution and M. Fuss and D. McFadden (eds.), Production Economics: A Dual Approach to Theory and Applications, Vol. 1, for mathematical formulations and proofs of these functions.

[44]See S. Clemhout, "The Class of Homothetic Isoquant Production Functions", Review of Economic Studies, Vol. 35, 1968, for a discussion.

[45]M. Denny, "The Relationship between Functional Forms for the Production System", Canadian Journal of Economics, Vol. 7, 1974, p. 21.

earlier, since they do not make any *a priori* assumptions about the elasticities of substitution or transformation.

Functional Form Selection

The function fitted will be of the Cobb-Douglas type. The Cobb-Douglas production function was first used by Paul Douglas and Charles Cobb[1] to measure the contribution of capital and labour to industrial output in America from 1899 to 1922. Following this pioneering study similar analyses have been done in farm management research. A review of some of these have been carried out by Parish and Dillon.[2] The Cobb-Douglas function is commonly expressed in the following form:

$$(2) \qquad Q = b_0 X_1^{b_1} X_2^{b_2} \ldots\ldots X_n^{b_n}$$

where Q represents the total quantity of any product; X_1, X_2 etc., are input factors; and the coefficients b_1, b_2 etc., are production elasticities. When equation 1 is transformed into logarithms, the function is reduced to the simple linear form:

$$(3) \qquad \ln Q = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 \ldots\ldots b_n \ln X_n$$

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[1] Paul H. Douglas and Charles W. Cobb, "A Theory of Production", American Economic Review , Vol. XVIII, Supplement, March 1928, pp. 139-65.

[2] R.M. Parish and J.L. Dillon, "Recent Applications of the Production Function in Farm Management Research", Review of Marketing and Agricultural Economics, Vol. 23, December 1955, pp. 215-36.

In this form the function can be solved by the coefficent estimation algorithm of multiple regression analysis.'' This property makes the function computationally convenient. Some of the other properties of the function which makes it useful in an economic context includes the following:

(a) The coefficient associated with each input factor represents the elasticity of the product with respect to that factor. This gives an estimate of the percentage change that would occur in output as a result of a one per cent change in the input of the factor.

(b) The phenomenon of returns to scale of the production process can be determined by adding the elasticities associated with each factor. When the sum of the elasticities is equal to unity, constant returns to scale exists; less than unity, diminishing returns to scale exists; and greater than unity, increasing returns to scale exists.

(c) The marginal productivity of any factor can be determined directly from the function by partial differentiation with respect to the factor concerned.'' However, the Cobb-Douglas function possesses the other two important properties of diminishing marginal productivity of factors and

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''Earl O. Heady, "Relationship of Scale Analysis to Productivity Analysis", in E. O. Heady *et al.*, (eds.) Resource Productivity, Returns to Scale and Farm Size , Iowa State College Press, 1956.

''For example, the marginal productivity of the factor X_1 in equation 2 would be determined from the formula:

$$\frac{\partial Q}{\partial X_1} = \frac{b_1 Q}{X_1}$$

diminishing marginal rates of substitution among factors.

(d) Another property of the function which enhances its use is that small errors in the data which are normally distributed, can have their normality preserved to a large extent by the logarithmic transformation of the variables; and even in the case where the errors are not independent and not normally distributed, the best linear estimate will be obtained through the method of least squares.[50]

This property is important in the situation presented by Antigua where few farmers keep records, consequently, errors in the data are very likely to occur.

Although several new, more flexible functional forms have been developed to overcome the restrictive assumptions of the Cobb-Douglas function, in particular the assumption of unitary elasticity of factor substitution; these new functional forms are computationally more difficult, and do very little to relax other restrictive assumptions imposed on the production structure.[51] Given this fact and also the fact that the production structure of small farmers in Antigua may well be characterized by constant returns to scale,[52] the Cobb-Douglas functional form is utilized in

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[50]Gerhard Tintner, "A Note on the Derivation of Production Functions from Farm Records", Econometrica, Vol. 12, No. 1, January 1944, p. 27.

[51]Edwin F. Ulveling and Lehman B. Fletcher, "A Cobb-Douglas Production Function with Variable Returns to Scale", American Journal of Farm Economics, Vol. 52, No. 1, Feb. 1970, p.322.

[52]Frank Mills in his Study of the Structure of Agriculture

this study.

Specification of the Model

The formal model used in this study can be specified as follows:

$$(4) \qquad Q = b_o A^{b_1} L^{b_2} K^{b_3}$$

and the estimated equation is of the form:

$$(5) \qquad \ln Q = \ln b_o + b_1 \ln A + b_2 \ln L + b_3 \ln K$$

where ln is the natural logarithm, Q is the gross annual produce of the farm, A is farm size in acres, L is the total labour input (in person-days), and K is the capital input. The latter includes farm equipment, buildings and land improvements such as leveling, irrigation, fencing, drains and terracing.

The Concept of Economic Efficiency

The concept of economic efficiency comprises two components - technical efficiency and price efficiency. Technical efficiency concerns the relationship between inputs and output. One firm is considered to be more technically efficient than another if its output, produced

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[52](cont'd) in St.Kitts found that the production structure of smallholders was characterized by constant returns to scale.

from the same quantities of measurable inputs, is consistently greater than that of the other firm. Price efficiency on the other hand, concerns profit maximization. Profit maximization requires that the firm uses its variable inputs up to the point where the value of the marginal product of each of these inputs is equal to its price. At this point the firm will be allocating its resources most efficiently.

A number of measures have been used to estimate economic efficiency in the literature. Early studies in farm management used net farm income as an index of efficiency. However, this measure proved unsatisfactory and was replaced by two other measures - the return to management and labour income (Heady, 1946). Another approach that has been used is the output-cost ratio. This involves the construction of a weighted average of inputs using either relative prices or relative factor shares, and comparing the weighted average to output (Paglin, 1965; Bennett, 1967).

Price or allocative efficiency is measured by comparing the marginal value product of a factor to its cost (Schultz, 1964; Hopper, 1965; Massell, 1967; Yotopoulos, 1968; Kalirajan, 1981). Technical efficiency on the other hand, is measured by estimating the change in the technical efficiency parameter of a firm over time (Hoch, 1955; Mundlak, 1961; Seitz, 1970; Yotopoulos and Lau, 1973).

The failure of the early measures in providing a satisfactory measure of efficiency, has led to the

development of a method of measuring efficiency based on the efficient unit isoquant. This method, proposed by Farrell in 1957, is illustrated in figure 4.1. The hallmark of the method lies in the measurement of the two components of efficiency independently. Consider a production process using capital (K) and labour (N) to produce a certain output. The efficient production frontier is represented by the isoquant II' and the input coefficients by A. Technical efficiency is measured by the ratio OB/OA and price efficiency by the ratio OC/OB. The product (OC/OA) of these two ratios gives the overall productive efficiency.

Farrell's approach has been criticized by Lau and Yotopoulos because of its failure to take account of the effects of relative prices and because of the deterministic nature of the method. They suggest that any new concept of economic efficiency should meet the following minimum requirements in order to be useful:

(a) Firms that produce different quantities of output from the same amount of inputs should be accounted for.

(b) Account should be taken of the fact that different firms succeed to varying degrees in their objective of profit maximization.

(c) It should take into account that firms face different market prices.[53]

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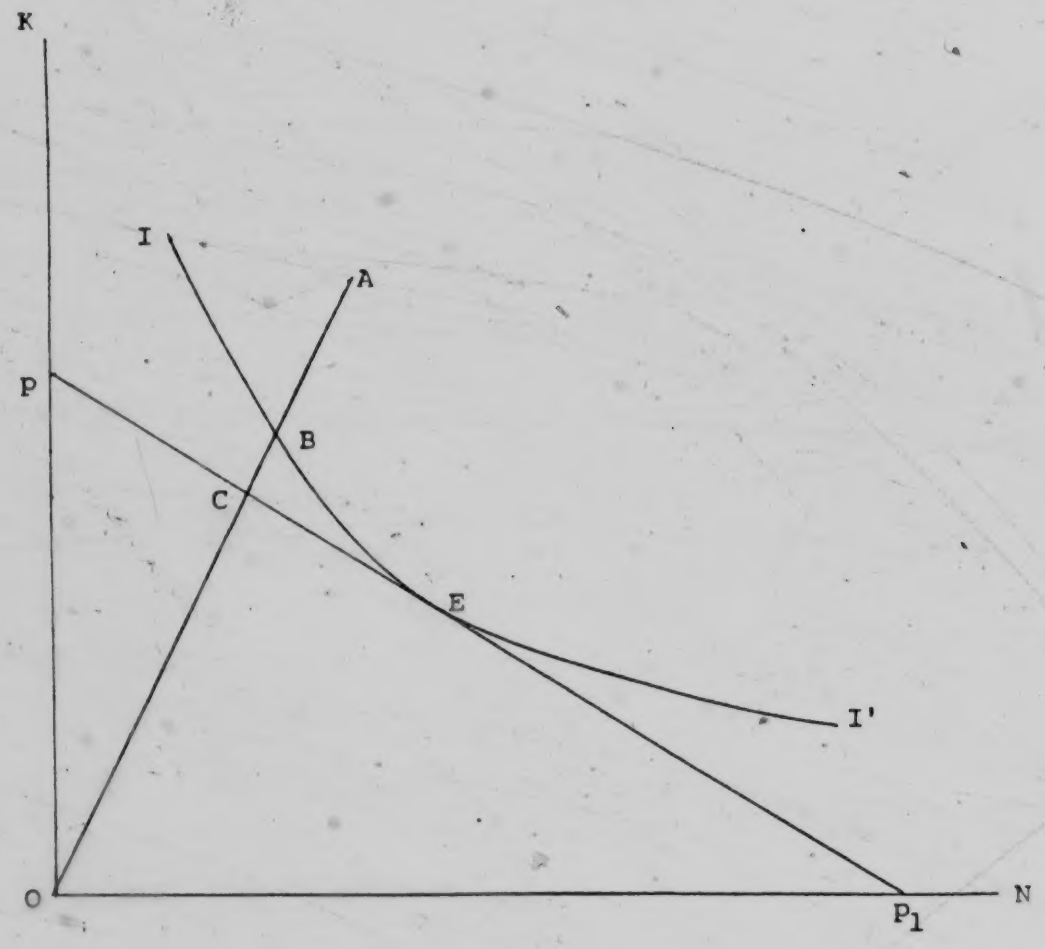
[53] Lawrence J. Lau and Pan A. Yotopoulos, "A Test for Relative Efficiency and Application to Indian Agriculture", American Economic Review, Vol. 61, 1971, p. 95.

Figure IV.1 Farrell's Measure of Technical and Allocative Efficiencies.



Lau and Yotopoulos use the unit output price (UOP) profit function instead of the production function in their analysis. From the UOP profit function, the economic efficiency of firms can be tested by testing for differences between their profit functions. The hypotheses of equal technical efficiency and equal price efficiency of two firms i.e., $A^1=A^2$ and $k^1=k^2$ respectively, can also be tested either separately or together. Although economic efficiency is comprised of technical efficiency and price efficiency, it is possible for two firms to have equal relative economic efficiency without having both equal technical efficiency and equal price efficiency.[54]

Allocative Efficiency

To measure and compare the allocative efficiency between part-time and full-time farms, the marginal productivities of the three input factors will be determined for both groups. The ratio (k) of marginal productivity and factor cost will indicate the allocative efficiency. For example, the allocative efficiency of labour can be calculated as follows:

$$(6) \qquad k = (b_2 Q/L)/P$$

where b_2 is the coefficient of the labour variable, Q is the

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[54] Pan A. Yotopoulos and Lawrence J. Lau, "A Test for Relative Economic Efficiency: Some Further Results", American Economic Review, Vol. 63, 1973, p. 216.

geometric mean of output, L is the geometric mean of the labour input and P the price of labour. If k is the same for both groups of farms then they would be considered to have equal allocative efficiency with respect to labour.[55]

Absolute allocative efficiency of a resource is achieved when k is equal to one. When k is less than one the resource is overutilized and conversely, when k is greater than one the resource is underutilized (Hopper, 1965; Sahota, 1968; Bagi, 1981). In most studies of resource allocation the criterion of efficiency used is the test of marginal value product against unity. However, a less stringent test can be used (i.e., where k is different to unity) to take into account market imperfections, weather vagaries, lagged responses and constraints on input expenditures etc., (Sahota, 1981).

C. Analysis of the Data

The questionnaires were coded and the responses entered into a computer file. The data for the two farm groups were analyzed using the SPSS-X statistical package. Frequencies, averages and standard deviations were determined for each variable in the sample.

A profile of each of the farm groups based on a number of social and economic characteristics was developed, and a comparative analysis undertaken to highlight the differences

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[55]A good example of this analysis can be found in chapter 4 of A Model of an Agricultural Household: Theory and Evidence, by Howard N. Barnum and Lyn Squire, World Bank Staff Occasional Papers, No. 27, 1979.

or similarities between the two groups.

Similarly, production function estimates were obtained for each group and the results compared. Hypotheses were tested for each group to determine whether the marginal productivity of each input is zero, whether the fitted equations were significant and whether the production functions were linearly homogeneous. Finally, a Chow test was used to determine whether the production functions of part-time and full-time farmers were different. Chapter 5 which follows gives an outline of the results.

V. Results and Discussion: A Comparison of Part-time and Full-time Farms

Before reporting the results it is necessary to explain the definition of the terms part-time and full-time farmers (operators), and to clarify the boundaries of inference.

A person who obtained less than 50% of their income from farming or worked more than 60 days but less than 180 days off-farm would be defined as a part-time farmer, while a person who obtained more than 50% of their income from farming or worked less than 60 days off-farm would be defined as a full-time farmer.

Because the sampling frame consisted of only those farmers who occupied government owned land, inference must be limited to this group of farmers. However, since the majority of farmers in Antigua have traditionally used this system of land tenure, inference can probably be drawn for the total farm population. This contention is supported by the close correspondence of the results observed between the present survey and the CARDI survey, since the latter sampled from the total farm population.

A. Characteristics of the Farmers

Sex

Males represented the majority of farmers in the sample. The ratio of male to female was almost 10:1 for part-time operators and 3:1 for full-time operators. In the

former there were twenty-nine (90.6%) males and three (9.4%) females, while the latter was comprised of twenty-one (75%) males and seven (25%) females (Table V.1).

In a 1980 farm survey undertaken by the Caribbean Agricultural Research and Development Institute (CARDI), it was reported that 79.2% of the farmers were males and 20.8% females. When the sexes for part-time and full-time operators in the present survey are combined, males represent 83.3% and females 16.7%. The Ministry of Agriculture small farmer survey in 1977 found that 25% of farm households were headed by women. It may be concluded that the present sample adequately represents the population according to sex of the principal operator.

Age

The majority of farmers were over 40 years old. For part-time operators the mean age was 56.9 years and the modal age 48, while full-time operators had a mean age of 55.5 years and modal age of 63 (Table V.2). The CARDI survey four years earlier found a mean age of 50 years and modal age of 52, while the Ministry of Agriculture survey found a mean age of 55 years. The findings of these three surveys highlight the absence of young farmers in Antigua.

Marital Status

Most of the farmers were married. In the case of part-time operators 65.6% were married and 21.9% were

Table V.1 Distribution of Part-time and Full-time Farm Operators by Sex, Antigua 1984.

	Part-time		Full-time	
Sex	No.	%	No.	%
Male	29	90.6	21	75
Female	3	9.4	7	25
Total	32	100	28	100

Source: Survey Results.

Table V.2 Distribution of Part-time and Full-time Farm Operators by Age, Antigua 1984.

	Part-time		Full-time	
Age	No.	%	No.	%
<26	0	0	1	3.6
26-40	3	9.4	6	21.6
41-55	13	40.7	4	14.4
56-70	10	31.2	12	42.9
71-85	6	18.7	5	17.9
Total	32	100	28	100

Source: Survey Results.

single. The figures for full-time operators were 42.1% and 32.1% respectively (Table V.3). In the CARDI survey of small farmers 65.9% were married legally, 18.4% were single and 2.5% were in common-law unions.

Education

The majority of farmers had some type of formal schooling. In the case of part-time operators 9.4% had completed the elementary stage, 87.5% had completed the primary stage and 3.1% had completed the secondary stage. For full-time operators 14.3% had completed the elementary stage, 21% had completed the primary stage, 7.1% had completed the secondary stage and 3.6% had completed college (Table V.4). As in the present survey, the CARDI survey also found educational attainment to be dominated by the primary stage, with 60.8% having completed primary and about 7% secondary schooling. The sample education profiles are compatible with the CARDI survey but also reveal that the full-time farmers are better educated than the part-time farmers.

Dependents

The number of dependents ranged from none to twelve for part-time operators and none to fourteen for full-time operators. For part-time operators 21.9% had one to three dependents, 43.7% had four to six dependents, 15.7% had seven to nine dependents and 15.6% had ten to twelve

Table V.3 Distribution of Part-time and Full-time Farm Operators by Marital Status, Antigua 1984.

	Part-time		Full-time	
Status	No.	%	No.	%
Single	7	21.9	9	32.1
Married	21	65.6	12	42.9
Divorced	1	3.1	2	7.1
Separated	1	3.1	2	7.1
Widowed	2	6.3	3	10.7
Total	32	100	28	100

Source: Survey Results.

Table V.4 Distribution of Part-time and Full-time Farm Operators by Educational Level, Antigua 1984.

	Part-time		Full-time	
Level	No.	%	No.	%
No Schooling	0	0	0	0
Elementary	3	9.4	4	14.3
Primary	28	87.5	21	75.0
Secondary	1	3.1	2	7.1
Col./University	0	0	1	3.6
Total	32	100	28	100

Source: Survey Results.

dependents. For full-time operators 28.6% had one to three dependents, 39.3% had four to six dependents, 10.7% had seven to nine dependents, 10.7% had ten to twelve dependents and 7.2% had thirteen to fifteen dependents (Table V.5). The CARDI survey found that 50% of small farmers had one to five dependents 28.4% had six to ten dependents and 21.6% had none. While both surveys indicate that the majority of farmers had one to five dependents, the present survey also revealed that part-time farmers had a larger number of dependents than full-time farmers.

Place of Residence

The farm and place of residence were rarely located at the same place. All of the part-time operators lived away from their farms. In the case of full-time operators only 14.3% lived on their farms while 85.7% lived elsewhere (Table V.6). The CARDI survey did not look specifically at farm and residential location, however, it found that 20% of small farmers have lived in the area where they farm for more than sixty years. The difference in farm and residential location can probably be explained by the low incidence of owner-occupied farms in the CARDI sample. Of the 120 small farmers in this sample 115 were annual renters, 4 were freehold and 1 was leasehold.

Table V.5 Distribution of Part-time and Full-time Farm Operators by Number of Dependents, Antigua 1984.

	Part-time		Full-time	
Dependents	No.	%	No.	%
None	1	3.1	1	3.6
1-3	7	21.9	8	28.6
4-6	14	43.7	11	39.3
7-9	5	15.7	3	10.7
10-12	5	15.6	3	10.7
13-15	0	0	2	7.2
Total	32	100	28	100

Source: Survey Results.

Table V.6 Distribution of Part-time and Full-time Farm Operators by Place of Residence, Antigua 1984.

	Part-time		Full-time	
Residence	No.	%	No.	%
On-Farm	0	0	4	14.3
Off-Farm	32	100	24	85.7
Total	32	100	28	100

Source: Survey Results.

Off-farm Employment

Part-time operators were highly represented in occupations that required no skills and also those that were agriculturally related. Almost 41% of part-time operators fell in the former category and 22% in the latter. Overall 87.5% of part-time operators engaged in off-farm employment compared to 10.8% of full-time operators (Table V.7). The fact that 100% of part-time operators did not have off-farm employment does not contradict the definition of part-time. What this means is that those farmers who did not have off-farm employment, derived less than 50% of their income from farming (and invariably in this case remittances from abroad were an important source of income).

In the CARDI survey it was found that 40.9% of small farmers engaged in such off-farm employment as fishing, labourers, security guards, trades and agriculture-related commerce. The Ministry of Agriculture survey found that of the 92 farmers responding to questions of off-farm employment, 48 (52%) reported spending at least half their labour time in off-farm jobs. All three surveys underscore the extent of part-time work. The concentration of part-time operators in off-farm employment which required no skills further attests to the low educational level of these farmers.

Table V.7 Distribution of Part-time and Full-time Farm Operators by Off-farm Employment, Antigua. 1984.

	Part-time		Full-time	
Employment	No.	%	No.	%
None	4	12.5	25	89.2
Civil Servant	1	3.1	0	0
Domestic	2	6.3	1	3.6
Driver	2	6.3	1	3.6
Skilled	2	6.3	0	0
Unskilled	13	40.6	0	0
Sales Related	1	3.1	0	0
Agri. Related	7	21.9	1	3.6
Total	32	100	28	100

Source: Survey Results.

Reason for Selecting Off-farm Employment

The reason most often cited for the selection of off-farm employment was income. In the case of part-time operators 84.4% cited income and 3.1% cited spare time as their reasons. All of the full-time operators who engaged in off-farm employment also cited income as their reason. Prestige was never mentioned as a factor in opting for off-farm employment (Table V.8). Although the farmers in the CARDI survey were not asked the reason for selecting their off-farm employment, 55.8% considered money to be the most important factor in selecting a job. The confirmation by both surveys that income was the most important factor in off-farm employment selection, would also support the economic rationale for part-time farming.

Labour Time

The modal weekly time spent on the farm during the cropping season on sowing, growing and harvesting activities was 11-20 hours for part-time operators, and 41-50 hours for full-time operators (Table V.9). The CARDI[5*] survey found that the modal group of weekly time spent on the farm was 28-42 hours, with 65% of the sample spending up to 42 hours and 14.2% spending 42-56 hours weekly. The smaller number of hours per week spent on the farm by part-time operators corresponds to their greater involvement in off-farm

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[5*]The time unit used in the CARDI survey was hours per day. The author changed this to hours per week by multiplying by 7.

Table V.8 Distribution of Part-time and Full-time Farm Operators by Reason for Selecting Off-farm Employment, Antigua 1984.

	Part-time		Full-time	
Reason	No.	%	No.	%
None	4	12.5	25	89.2
Income	27	84.4	3	10.8
Time	1	3.1	0	0
Prestige	0	0	0	0
Total	32	100	28	100

Source: Survey Results.

Table V.8 Distribution of Part-time and Full-time Farm Operators by Labour Time (Hrs/Wk), Antigua 1984.

	Part-time						Full-time					
	Sowing		Growing		Harvesting		Sowing		Growing		Harvesting	
Time	No.	%	No.	%	No.	%	No	%	No.	%	No.	%
1-10	5	15.9	6	18.8	8	25.2	0	0	0	0	2	7.1
11-20	14	45.7	14	43.7	15	46.9	4	14.2	3	10.7	3	10.7
21-30	8	25.1	6	15.8	5	15.7	3	10.8	4	14.3	4	14.3
31-40	2	6.2	4	12.5	2	6.2	4	14.2	3	10.7	3	10.7
41-50	2	6.2	1	3.1	1	3.1	9	32.1	10	35.7	9	32.1
51-60	0	0	1	3.1	1	3.1	3	10.7	4	14.3	3	10.7
61-70	0	0	0	0	0	0	3	10.7	3	10.7	3	10.7
71-80	1	3.1	0	0	0	0	2	7.1	1	3.6	1	3.6
Total	32	100	32	100	32	100	28	100	28	100	28	100

Source: Survey Results.

employment.

B. Characteristics of the Farms

Parcels Farmed, Size and Years Occupied

For part-time operators 53.1% cultivated one parcel, 43.8% cultivated two parcels and 3.1% cultivated three parcels. For full-time operators 75% cultivated one parcel, 14.3% cultivated two parcels, 7.1% cultivated three parcels and 3.6% cultivated four parcels (Table V.10). The mean number of parcels per farm was 1.5 for part-time and 1.42 for full-time operators. The parcel sizes ranged from one half of an acre to six acres, and one quarter of an acre to seventeen acres for part-time and full-time operators respectively. The mean farm size was 3.19 acres for part-time and 4.75 acres for full-time operators. Table V.11 shows the distribution of farms for part-time and full-time operators by number and size of parcels cultivated.

Farm occupancy ranged from one year to sixty years. For part-time operators 32.8% have occupied their farms between 1-5 years, 7.8% between 6-10 years, 17.1% between 11-15 years, 10.9% between 16-20 years and 3.1% between 46-50 years. For full-time operators 22.6% have occupied their farms between 1-5 years, 7.1% between 6-10 years, 17.9% between 11-15 years, 10.7% between 16-20 years, 7.1% between 36-40 years, 7.1% between 46-50 years and 3.6% between 56-60 years (Table V.12). The mean occupancy was 12.6 years and

Table V.10 Distribution of Part-time and Full-time Farms by Number of Parcels Farmed, Antigua 1984.

	Part-time		Full-time	
Parcels	No.	%	No.	%
1	17	53.1	21	75.0
2	14	43.8	4	14.3
3	1	3.1	2	7.1
4	0	0	1	3.6
Total	32	100	28	100

Source: Survey Results.

Table V.11 Distribution of Part-time and Full-time Farms by Parcel Number and Size (Acres). Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Size	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	-	-	17	53.1	31	96.9	32	100	-	-	21	75.0	25	89.3	27	96.4
0-1.9	8	24.9	5	15.7	1	3.1	0	0	6	21.5	1	3.6	1	3.6	0	0
2-4.9	19	62.5	9	28.1	0	0	0	0	16	57	5	17.8	1	3.6	1	3.6
5-7.9	4	12.5	1	3.1	0	0	0	0	3	17.9	1	3.6	0	0	0	0
8-10.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11+	0	0	0	0	0	0	0	0	1	3.6	0	0	1	3.6	0	0
Total	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Table V.12 Distribution of Part-time and Full-time Farms by Parcel Number and Years Occupied by Operator, Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Years	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	-	-	17	53.1	32	100	32	100	-	-	21	75.0	25	89.3	27	96.4
1-5	15	47.0	6	18.7	0	0	0	0	14	50.0	3	10.7	2	7.2	1	3.6
6-10	4	12.5	1	3.1	0	0	0	0	4	14.3	1	3.6	1	3.6	0	0
11-15	8	25.0	3	9.3	0	0	0	0	5	17.9	0	0	0	0	0	0
16-20	3	9.4	4	12.5	0	0	0	0	3	10.7	0	0	0	0	0	0
21-25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-30	1	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36-40	0	0	0	0	0	0	0	0	0	0	2	7.1	0	0	0	0
41-45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46-50	1	3.1	1	3.1	0	0	0	0	2	7.1	0	0	0	0	0	0
51-55	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0
56-60	0	0	0	0	0	0	0	0	0	0	1	3.6	0	0	0	0

Source: Survey Results.

13.6 years for part-time and full-time operators respectively.

When the mean number of parcels farmed, size and years of occupancy are compared for both types of farms, the differences appear to be small. However, the greater number of parcels per farm on part-time farms is unexpected given the greater involvement of part-time operators with off-farm employment.

Distance, Means of Travel and Time to Parcel

For part-time operators cultivating one parcel 90.7% lived within two miles of their farms, and 9.3% lived between two and five miles. The figures for those cultivating two parcels were 37.4% and 6.3% respectively. In the case of full-time operators cultivating one parcel 64.3% lived within two miles of their farms, 14.3% lived between two and five miles and 7.1% lived between six to eight miles. Only one farm was located more than nine miles from the farmer's home (Table V.13).

Walking was the most common mode of travel used in getting to the farm and cycling the least. Other popular modes included donkey, car, bus and truck (Table V.14). All the farmers took less than one hour to get to their farms. The majority took between eleven to twenty minutes (Table V.15).

The majority of both types of farms were located within two miles of the farmers' homes.

Table V.13 Distribution of Part-time and Full-time Farms by Parcel Number and Distance from Home (Miles), Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Dist.	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	0	0	18	56.3	31	96.9	32	100	4	14.3	22	78.5	26	92.9	27	96.4
0-2	29	90.7	12	34.7	1	3.1	0	0	18	64.3	4	14.3	1	3.6	1	3.6
3-5	3	9.3	2	6.3	0	0	0	0	4	14.3	1	3.6	0	0	0	0
6-8	0	0	0	0	0	0	0	0	2	7.1	1	3.6	0	0	0	0
9-11	0	0	0	0	0	0	0	0	0	0	0	0	1	3.6	0	0
Total	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Table V.14 Distribution of Part-time and Full-time Farms by Parcel Number and Means of Travel to Farm, Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Means	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	0	0	18	56.3	32	100	32	100	1	3.6	21	75.0	25	89.3	27	96.4
Walk	19	59.4	7	21.9	0	0	0	0	13	46.4	2	7.1	1	3.6	0	0
Donkey	4	12.5	2	6.3	0	0	0	0	7	25.0	1	3.6	0	0	0	0
Car	4	12.5	1	3.1	0	0	0	0	2	7.1	0	0	0	0	0	0
Bus	2	6.3	1	3.1	0	0	0	0	1	3.6	1	3.6	0	0	0	0
Truck	2	6.3	2	6.3	0	0	0	0	3	10.7	3	10.7	2	7.1	1	3.6
Bicycle	1	3.1	1	3.1	0	0	0	0	1	3.6	0	0	0	0	0	0
Total	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Table V.15 Distribution of Part-time and Full-time Farms by Parcel Number and Time to Parcel from Home (Minutes), Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Time	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	0	0	18	56.3	32	100	32	100	4	14.3	22	78.6	26	92.9	27	96.4
1-10	10	31.3	7	21.9	0	0	0	0	5	17.9	3	10.8	1	3.6	1	3.6
11-20	16	50.1	2	6.3	0	0	0	0	11	39.3	0	0	0	0	0	0
21-30	5	15.6	2	6.3	0	0	0	0	5	17.8	1	3.6	0	0	0	0
31-40	1	3.1	1	3.1	0	0	0	0	1	3.6	1	3.6	0	0	0	0
41-50	0	0	2	6.2	0	0	0	0	2	7.2	1	3.6	1	3.6	0	0
Total	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Distance from Paved Road

For part-time operators 26% of the farms are located between 1-100 yards from a paved road, 6.2% between 101-200 yards, 14.1% between 201-300 yards, 7.8% between 301-400 yards and 3.1% between 701-800 yards. In the case of full-time operators 28.5% of the farms are located 1-100 yards from a paved road, 17.9% between 101-200 yards, 14.2% between 201-300 yards and 3.6% between 701-800 yards (Table V.16).

Athough the majority of both types of farms are located between one to one hundred yards from a paved road, accessibility to the farm can become quite difficult for vehicular traffic when it rains since most of the access roads are the dry weather type. Nevertheless, farms can be considered to be easily accessible by road transport for purposes of input supply and product marketing.

Tools, Equipment, Machinery and Farm Buildings

Full-time farmers used more capital than part-time farmers. For part-time operators 71.9% owned 1-2 machettes, 81.3% owned 1-2 hoes and 81.3% owned 1-2 forks. For full-time operators 50% owned 1-2 machettes, 57.1% owned 1-2 hoes and 64.2% owned 1-2 forks (Table V.17).

Knapsack sprayers, which were present on 59.3% of part-time and on 64.2% of full-time farms, were the most common piece of hardware. Of the thirty-two part-time operators in the sample two owned trucks, four owned cars,

Table V.16 Distribution of Part-time and Full-time Farms by Parcel Number and Distance from Paved Road (Yards), Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Dist.	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	0	0	17	53.1	31	96.9	32	100	0	0	21	75.0	25	89.3	27	96.4
1-100	17	53.1	7	21.9	1	3.1	0	0	17	60.7	4	14.3	3	10.7	1	3.6
101-200	3	9.4	1	3.1	0	0	0	0	5	17.9	0	0	0	0	0	0
201-300	7	21.9	2	6.3	0	0	0	0	4	14.2	0	0	0	0	0	0
301-400	2	6.2	3	9.4	0	0	0	0	1	3.6	1	3.6	0	0	0	0
401-500	1	3.1	1	3.1	0	0	0	0	1	3.6	1	3.6	0	0	0	0
501-600	1	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
601-700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
701-800	1	3.1	1	3.1	0	0	0	0	1	3.6	1	3.6	0	0	0	0
Total	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Table V.17 Distribution of Part-time and Full-time Farms by Number of Hand Tools, Antigua 1984.

	Part-time						Full-time					
	Machette		Hoe		Fork		Machette		Hoe		Fork	
Number	No.	%	No.	%	No.	%	No	%	No.	%	No.	%
None	1	3.1	-	-	5	15.6	6	21.4	2	7.1	10	35.7
1-2	23	71.9	26	81.3	26	81.3	14	50.0	16	57.1	18	64.2
3-4	6	18.8	4	12.5	0	0	7	25.0	7	25.0	0	0
5-6	2	6.2	2	6.2	0	0	0	0	1	3.6	0	0
7-8	0	0	0	0	1	3.1	1	3.6	2	7.2	0	0
Total	32	100	32	100	32	100	28	100	28	100	28	100

Source: Survey Results.

two owned some type of irrigation equipment, two owned seed planters, one owned a storeroom and only one had a livestock pen. Of the twenty-eight full-time operators two owned tractors, five owned trucks, two owned cars, six owned irrigation equipment, one owned a seed planter, seven owned storerooms and three owned pens (Table V.18). On average part-time farms had E.C.$3443 of capital and full-time farms E.C.$8888.

The CARDI results were consistent with those of this research. Both surveys indicated the general lack of physical capital assets on the vast majority of farms. In the CARDI survey 67.5% of the sample owned 1-5 pieces of hand tools and 29.2% owned 6-10 pieces. Knapsack sprayers were owned by 28.3% of the sample. Of the 120 farmers in the sample six owned trucks, two owned tractors, five owned some type of irrigation equipment; and in terms of buildings, only two cow pens, one sheep/goat pen and one storeroom were present in the entire sample.

Credit Source

Credit facilities were not widely utilized by small farmers in Antigua. As table II.5 indicates, the number of loans approved by the Antigua and Barbuda Development Bank decreased from 62 in 1979 to 28 in 1982. This survey found that twenty-three (71.8%) part-time and seventeen (60.7%) full-time operators had never borrowed. Of those who had borrowed, 3.1% used the commercial banks, 18.7% used the

Table V.18 Distribution of Part-time and Full-time Farms by Equipment, Machinery and Farm Buildings, Antigua 1984.

	Part-time		Full-time	
	No.	%	No.	%
Tractor	0	0	2	7.1
Plow	0	0	0	0
Truck	2	6.2	5	17.8
Car	4	12.5	2	7.1
Irrigation	2	6.2	6	21.4
Sprayer	19	59.3	18	64.2
Planter	2	6.2	1	3.5
Shed	0	0	0	0
Storeroom	1	3.1	7	25.0
Pens	1	3.1	3	10.7

Source: Survey Results.

Antigua and Barbuda Development Bank and 6.2% used the commercial banks, 28.5% used the Antigua and Barbuda Development Bank and 3.5% borrowed from friends or relatives (Table V.19).

The CARDI survey found that 94.2% of the farmers in the sample had never borrowed; and of those who did, 5% obtained loans from the Antigua and Barbuda Development Bank and 2.5% from the commercial banks. In the Ministry of Agriculture survey 14% of the farmers dealt with the Antigua and Barbuda Development Bank and 4% with the commercial banks.

As with the present survey, the other two surveys found that the majority of small farmers did not use credit and that those who did, borrowed primarily from the Antigua and Barbuda Development Bank.

Livestock Enterprises

The rearing of livestock by small farmers in Antigua was not a common practise. Those farmers who had livestock enterprises kept their animals off-farm. For part-time operators who reared cattle 9.3% had 1-5, 6.2% had 6-10 and 3.1% had 11-15. No sheep, goats or chickens were kept by part-time operators and only five kept pigs. For full-time operators who reared cattle 7.1% had 1-5, 3.5% had 6-10 and 7.2% had more than 15. None of the full-time operators kept sheep; while two kept pigs, two kept goats and two kept poultry (Table V.20). Livestock enterprises were present on 56.2% of part-time and 28.5% of full-time farms.

Table V.19 Distribution of Part-time and Full-time Farms by Credit Source, Antigua 1984.

	Part-time		Full-time	
Source	No.	%	No.	%
None	23	71.8	17	60.7
Commercial Bank	1	3.1	1	3.5
A.B.D.B.	6	18.7	8	28.5
Friend/Relative	0	0	1	3.5
Farmers Asso.	0	0	0	0
P.D.O.	2	6.2	0	0
No Response	0	0	1	3.5
Total	32	100	28	100

Source: Survey Results.

Table V.20 Distribution of Part-time and Full-time Farms by Number of Livestock, Antigua 1984.

	Part-time										Full-time									
	Cattle		Sheep		Goat		Pig		Chicken		Cattle		Sheep		Goat		Pig		Chicken	
	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
None	26	81.2	32	100	32	100	27	84.4	32	100	24	85.7	28	100	26	92.9	26	92.9	26	92.9
1-5	3	9.3	0	0	0	0	3	9.3	0	0	2	7.1	0	0	0	0	1	3.6	1	3.6
6-10	2	6.2	0	0	0	0	2	6.2	0	0	1	3.6	0	0	2	7.2	1	3.6	0	0
11-15	1	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>>15	0	0	0	0	0	0	0	0	0	0	1	3.6	0	0	0	0	0	0	1	3.6
Total	32	100	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Of the 120 farms in the CARDI sample, livestock were only kept on six. These livestock included cattle on three farms, pigs on two and sheep and goats on one. Only one farmer kept chickens. While both surveys indicated that livestock enterprises were not common on small farms in Antigua, the present survey also revealed that the existence of these enterprises were greater on part-time farms.

Crop Enterprises

The crops most frequently grown by Antiguan small farmers were root crops and vegetables. For part-time operators 21.8% grew yams, 31.2% grew cassava and 53.1% grew sweet potatoes. The figures for these three root crops for full-time operators were 10.7%, 14.2% and 25% respectively. The four most frequently grown vegetables by both part-time and full-time operators were carrots, cucumbers, tomatoes and egg plants. In the case of part-time operators 28.1% grew carrots, 43.7% grew cucumbers, 25% grew tomatoes and 21.8% grew egg plant. For full-time operators 50% grew carrots, 39.2% grew cucumbers, 46.4% grew tomatoes and 32.1% grew egg plant. Some of the other crops which were grown by both part-time and full-time operators included corn, sweet pepper and squash. Tree crops were the least frequently grown. Thirteen (40.6%) part-time operators grew sugar cane and three (9.3%) grew cotton. The figures for these two non-food crops for full-time operators were three (10.7%) and two (7.1%) respectively (Table V.21).

Table V.21 Distribution of Part-time and Full-time Farms by Crops, Antiqua 1984.

Crops	Part-time		Full-time	
	No.	%	No.	%
Yam	7	21.8	3	10.7
Cassava	10	31.2	4	14.2
S. Potatoes	17	53.1	7	25.0
Eddo	0	0	2	7.1
Corn	5	15.6	6	21.4
Carrot	9	28.1	14	50.0
Beet	4	12.5	4	21.4
Cucumber	14	43.7	11	39.2
Cabbage	3	9.3	9	32.1
Lettuce	0	0	2	7.1
Pumpkin	4	12.5	4	14.2
Tomato	8	25.0	13	46.4
Okra	6	18.7	5	17.8
Egg Plant	7	21.8	9	32.1
Onion	2	6.2	2	7.1
S. Pepper	7	21.8	9	32.1
H. Pepper	0	0	4	14.2
Butternut	2	6.2	4	14.2
B/eye Peas	0	0	2	7.1

Table V.21 (Cont'd)

Crops	Part-time		Full-time	
	No.	%	No.	%
String Beans	1	3.1	0	0
White Beans	0	0	1	3.5
Pigeon Peas	1	3.1	2	7.1
Squash	6	18.7	7	25.0
Bush Beans	4	12.5	1	3.5
Mango	4	12.5	2	7.1
Coconut	1	3.1	2	7.1
Papaya	0	0	2	7.1
Bananas	2	6.2	5	17.8
Sugar Apple	0	0	1	3.5
Lemon	0	0	0	0
Mellon	4	12.5	3	10.7
Pear	1	3.1	0	0
Cotton	3	9.3	2	7.1
Sugar Cane	13	40.6	3	10.7
Peanut	1	3.1	2	7.1

a) Totals for No. and % could not be shown at the bottom of the table because of the way the table is constructed.

Source: Survey Results.

An average of five crops per farm was grown on part-time farms; with sweet potatoes, carrots, cucumbers and tomatoes having the highest frequency of occurrence in crop combinations. For full-time farms, an average of six crops per farm was grown; with sweet potatoes, corn, carrots, tomatoes, cucumbers and egg plant occurring most frequently in crop combinations. Bananas, corn, eddoes and okra had the highest frequency of occurrence in crop combinations in the CARDI survey. From the evidence of both surveys, it can be concluded that mixed cropping is a feature of small farming in Antigua.

Incidence of Unused Land

Very little unutilized land was present on the sample farms. The proportion of unused land was 12.4% for part-time and 10.8% for full-time operators (Table V.22). In the CARDI survey only 2 of the 120 farms in the sample contained unutilized land, and in each case the amount of unutilized land was less than one acre. While both surveys indicated that farmers almost completely utilized their land, the present survey also revealed that land utilization was less on part-time farms. This could probably be explained by the greater number of parcels per farm on part-time farms and the greater involvement in off-farm employment by part-time farmers.

Table V.22 Distribution of Part-time and Full-time Farms by Parcel Number and Unused Land per Parcel (Acres), Antigua 1984.

	Part-time								Full-time							
Parcel	1		2		3		4		1		2		3		4	
Unused	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%
None	29	90.6	31	96.9	32	100	32	100	26	92.9	27	96.4	28	100	25	100
< 1	1	3.1	0	0	0	0	0	0	2	7.2	1	3.6	0	0	0	0
1-2	2	6.2	1	3.1	0	0	0	0	0	0	0	0	0	0	0	0
Total	32	100	32	100	32	100	32	100	28	100	28	100	28	100	28	100

Source: Survey Results.

Marketing Outlets

Farm products were marketed through a number of channels. However, the most frequently used channel was the traditional method of hawking and vending. This method was used by fifteen (46.8%) part-time and nineteen (67.9%) full-time operators. A number of farmers marketed their products through several channels simultaneously. However, those farmers who grew sugar cane sold their crop to the sugar factory (Table V.23). The greater number of farmers who used the traditional method of hawking and vending as oppose to the Central Marketing Corporation to market their products, could probably be explained by the greater price flexibility of the former.

C. Production Functions

Estimates

The functional estimates of production elasticities for part-time and full-time farm operators were derived by taking the logs of output and input data and fitting them to a Cobb-Douglas function using ordinary least-squares. The estimates derived were,

(1) Part-time $\ln Q = 10.862 + 1.333 \ln A - 1.089 \ln L - 0.109 \ln K$
(0.433) (0.434) (0.160)
$R^2 = 0.33$

(2) Full-time $\ln Q = 0.078 + 0.138 \ln A + 0.592 \ln L + 0.412 \ln K$
(0.373) (0.735) (0.132)
$R^2 = 0.44$

Table V.23 Distribution of Part-time and Full-time Farms by Marketing Outlets for Produce, Antigua 1984.

Outlets	Part-time		Full-time	
	No.	%	No.	%
1. Hawkers and Vendors	15	46.8	19	67.9
2. C.M.C.	3	9.4	0	0
3. Hotels	0	0	1	3.6
4. Sugar Factory	7	21.9	2	7.1
5. Combination of 1-2	2	6.3	2	7.1
6. Combination of 1-3	1	3.1	3	10.7
7. Combination of 1-2-3	0	0	1	3.6
8. Combination of 1-4	3	9.4	0	0
9. Combination of 2-4	1	3.1	0	0
Total	32	100	28	100

Source: Survey Results.

where ln is the natural logarithm, Q is the annual gross output of the farm, A is farm size in acres, L is total labour input (in person-days) and K is the capital input.

First-Order Tests of Significance of the Estimates

The coefficient of multiple determination (R^2) denotes the variation in output that is explained by the independent variables. R^2 was 33 per cent for part-time and 44 per cent for full-time operators. Both values of R^2 were significant at the 5% probability level.

The hypothesis test that the elasticity of production of each input is zero was computed as follows:

$$(3) \qquad t = b_i / \text{std. error of } b_i \text{ with } (N-K)^1 df$$

where the numerator is the estimate and the denominator the standard error of the estimate; (N-K) is the number of degrees of freedom, where N is the number of observations and K the number of parameters, including the constant. The *t* values of land and labour elasticities for part-time operators were significant at the 5% level. However, the negative elasticity of labour is meaningless, since it is unlikely that production would decrease when labour input is increased. In the case of full-time operators, only the *t* value for capital was significant at the 5% probability level.[5']

[5']The ten worst outliers of both regressions were excluded and new functions estimated. While R^2 increased from 33% to

An *F* test was used to determine the overall significance of the regressions. The fitted equations for both part-time and full-time operators were significant at the 5% probability level. Given the overall significance of the fitted equation for full-time operators at the 5% level of probability, the insignificance of the regression coefficients for land and labour could be accommodated to some degree.[58]

Elasticity of Production

All the production elasticities were positive except those of labour and capital for part-time operators. While a negative sign for labour could have been expected, the negative sign for capital was not. The sign and magnitude of the elasticity of production with respect to capital was -0.109 for part-time and 0.412 for full-time farms. The elasticity of production of capital from other studies of smallholder agriculture are 0.172 (Bagi, 1981), 0.426 (Osuntogun, 1980) and 0.255 (Pemberton, 1981). The elasticity of production with respect to labour in all of these studies was positive except in Bagi's study.

For part-time operators land had the highest elasticity of production, while capital had the highest elasticity of

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[57](cont'd) 58% for part-time and from 44% to 76% for full-time farms, the signs and significance of the estimates did not change from those reported initially.

[58]E. O. Heady, "Productivity and Income of Labour and Capital on Marshall Silt loam Farms in Relation to Conservation Farming"; Iowa State Agricultural Experiment Research Bulletuin, 401, October 1953.

production for full-time operators. The elasticity of production indicates the percentage by which output increases as a factor of input is increased by 1 per cent.

The single negative elasticity and the low coefficient of multiple determination in the present study are typical of primary data from small farms. Errors in measurement, high variability among observations and crop failures due to drought in the year of the survey contributed to high standard errors. Multicollinearity was suspected to have contributed to the negative sign of the labour elasticity for part-time farmers. That possibility was tested and the correlation coefficients between all pairs of independent variables were small. The largest partial correlation coefficient existed between capital and land, and the value was only 0.568.

The Hypothesis of Linear Homogeneity

To test the hypothesis of linear homogeneity, the restriction $b_1+b_2+b_3=1$ was imposed on the elasticities and new regressions fitted. The estimates derived were,

(4) Part-time $\ln Q = 9.195 + 0.891 \ln A - 0.685 \ln L - 0.632 \ln K$
(0.390) (0.299) (0.114)
$R^2 = 0.24$

(5) Full-time $\ln Q = 5.382 + 0.629 \ln A - 0.238 \ln L + 0.244 \ln K$
(0.354) (0.489) (0.123)
$R^2 = 0.48$

Using an *F* test at the 5% probability level, the production function for full-time operators was found to be linearly homogeneous, while that for part-time operators was not. This test would suggest that the production process of full-time operators was probably characterized by constant returns to scale, while that of part-time operators was characterized by decreasing returns to scale.

A Chow test,[5] was used to determine whether the estimated production relationships of the unrestricted functions for part-time and full-time operators were significantly different. The test indicated that both relationships did not differ significantly at the 5% probability level.

Resource Productivity

The marginal value products and allocative efficiency ratios based on the unrestricted estimates irrespective of their significance are presented in table V.24. The marginal value productivity of land was 574.9 for part-time and 66.2 for full-time operators. The higher land productivity of part-time operators may partly be explained by the smaller farm size and the value of crops produced. The marginal value productivity of labour was -13.4 for part-time and 5.74 for full-time operators, while the marginal value productivity of capital was -0.04 and 0.10 for part-time and

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[5] G. C. Chow, "Tests of Equality between Sets of Coefficients in two Linear Regressions", Econometrica, Vol. 28, No. 3, July 1960.

full-time operators respectively.

Table V.24 MVP, Factor Cost and Allocative Efficiency Ratio (k)

	Part-time	Full-time
Marginal Value Product		
Land (E.C.$/acre)	574.9	66.2
Labour (E.C.$/person-day)	-13.4	5.74
Capital (E.C.$/E.C.$)	-0.04	0.10
Factor Cost		
Land (E.C.$/acre)	10	10
Labour (E.C.$/person-day)	20	20
Capital (E.C.$/E.C.$)	1.12	1.12
Allocative Efficiency Ratio		
Land	57.4	6.62
Labour	-0.67	0.28
Capital	-0.03	0.08

a) The elasticity values of land and labour for full-time farms and capital for part-time farms are really 0 but the actual calculated values are used in the calculation of MVP.

Source: Survey Results.

The ratio (k) of marginal value product to factor cost indicates the efficiency of resource utilization. This indicator is premised on the assumption that producers maximize profit and therefore, equate marginal revenue to marginal cost. Both part-time and full-time operators were inefficient in the use of all inputs since k was not near to unity for any input. In both cases the position was one of underutilization of land and overutilization of labour and capital. However, the deviation from the absolute efficiency criterion i.e., where k=1 was less for full-time operators for land and labour, but was greater in the case of capital.

Structural Differences

The data presented in Tables III.1 and V.25 highlight the structural differences between part-time and full-time farms. In terms of resource use, full-time farms used larger amounts of labour, land and capital than did part-time farms (Table III.1).

The smaller capital/labour ratio for part-time farms suggests that labour was used more intensely with respect to capital on these farms. From the land/labour ratios of 0.03 acres per day for part-time and 0.02 acres per day for full-time farms, it can be concluded that the combination of land and labour on both types of farms was similar. The capital/land ratio for part-time farms was slightly greater than half that of full-time farms (E.C.$1079 per acre compared to E.C.$1871 per acre) indicating a more intensive

Table V.25 Input and Output Ratios of Part-time and Full-time Farms, Antigua 1984.

Ratios	Part-time	Full-time
Capital/Labour ($/day)	30.8	37.8
Capital/Land ($/acre)	1079.3	1871.2
Land/Labour (Acre/day)	0.03	0.02
Output/Labour ($/day)	12.3	9.69
Output/Land ($/acre)	431.3	478.9
Output/Capital ($/$)	0.39	0.25

a) Dollars are in Eastern Caribbean Currency ($1.00 E.C. = $0.37 U.S.).

Source: Survey Results.

use of capital on full-time farms. In terms of output ratios, part-time farms had higher output/labour and output/capital ratios than full-time farms (Table V.25).

The data imply that both types of farms should generally increase their use of land while decreasing the use of labour and capital. By increasing the land/labour and land/capital ratios the marginal productivities of labour and capital would increase relative to the marginal productivity of land. Thus the observed disequilibria in resource use i.e., underutilization of land and overutilization of labour and capital would lessen.

D. Discussion of the Results

In the sample of sixty small farmers thirty-two (53.3%) were part-time and twenty-eight (46.6%) full-time operators. The greater proportion of part-time farm operators can be explained according to evidence given by the farmers, by economic necessity, since the returns from farming are usually too low to adequately meet the needs of the farm family. The average returns for 1984 were E.C.$1375 (U.S.$509) for part-time and E.C.$2275 (U.S.$842) for full-time farms. The Ministry of Agriculture survey in 1977 found an average return of E.C.$1000 (U.S.$370). The lack of economic opportunity demonstrated by these low returns could also help to explain the absence of young people in farming.

Apart from the climatic constraint on agricultural production, the results demonstrated that inefficient

resource use may have also contributed to low productivity and income. Resource productivity on both types of farms was higher for land than it was for labour and capital.

Land

The high marginal value product of land observed for both types of farms can be explained by the small size of these farms. However, the large difference in productivity between both types of farms (E.C.$574 for part-time compared to E.C.$66 for full-time) can probably be explained by better technology on part-time farms. It should be noted that farm size is not limited by the price of land (the annual rent is E.C.$10 per acre) but rather by institutional rigidity. The latter also manifests itself in the large proportion of arable land that remains unoccupied. In 1975 almost 65% of arable land in Antigua was unoccupied (See Table II.4) and the situation has changed little since that time. While some farm enlargement has taken place, as indicated by the change in the average farm size from 0.5 hectare in 1974 to 1.29 hectares (3.19 acres) for part-time farms and 1.92 hectares (4.75 acres) for full-time farms in 1984; the economic and developmental potential of further farm enlargement have not been exhausted.

Another important feature of small farming observed in Antigua was the general lack of farm fragmentation. The majority of both part-time and full-time farms consisted of only one parcel. The reasons for this can be attributed to

the government's emphasis on leasehold tenure, and the homogeneity in agro-climatic zones. The merits and demerits of the issue of fragmentation in the Caribbean have been discussed by a number of individuals. For example, Brierley (1978) argued that there was little economic and agricultural justification for fragmentation in Grenada; Hills Iton and Lundgren (1972) have maintained that fragmentation may be economically and socially advantageous for the Commonwealth Caribbean under certain circumstances; and Edwards (1961) claimed that the advantages of fragmentation are usually outweighed by the disadvantages. However, the author feels that a greater degree of fragmentation in Antigua than that which presently exists, would lead to even more inefficient resource use. In some situations fragmentation could also impede land reforms designed to increase farm size.

Labour

The marginal value product of labour on part-time farms was uninterpretable but probably zero and on full-time farms was zero. This phenomenon can partly be explained by the age of the farmers (the modal age was 48 years for part-time and 63 years for full-time operators) which could have the effect of locking them into farming, since for the majority of these farmers the opportunity cost of labour off the farm is probably zero or very low.

The observation in this study of labour overutilization is maintained in a number of other studies dealing with the allocation of resources by small farmers in developing countries. For example, the results of Pemberton's[10] study in Tobago and studies done in Nigeria by Osuntogun[11] and Ogunfowora *et al.*[12] also showed that labour was apparently in excess supply. Interpretation of excess supplies however should be cautioned on small farms where subsistence and tradition may take priority over productive activities for labour use.

Capital

Like labour, the marginal value product of capital was also low. In fact, the MVP of capital was not significantly different from zero for part-time farms. The phenomenon of overcapitalized farms is universal since capital is commonly acquired as a consumer durable and to offset risk. However, in the sample of Antiguan farms there was a noticeable lack of physical capital assets on most farms; therefore, the finding in this study of overcapitalization may be explained by the influence of the excessive use of capital on a few

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[10] C. A. Pemberton, "Resource Productivity in Agriculture in Developing Countries: A Comment", Canadian Journal of Agricultural Economics, Vol. 29, November 1981.

[11] A. Osuntogun, "A Study of Resource Productivity in Co-operative Group Farming in Imo State in Nigeria", Canadian Journal of Agricultural Economics, Vol. 28, No. 3, 1980

[12] O. Ogunfowora, S.M. Essang and O. Olayide, "Resource Productivity in Traditional Agriculture: A Case Study of four Agricultural Divisions in Kwara State of Nigeria", Journal of Rural Economics and Development, Vol. 9, No. 2, November 1975.

farms. For example, one part-time farm of 5.5 acres had an investment in capital of E.C.$45,221 and a full-time farm of 7 acres had an investment in capital of E.C.$132,868 (See Appendices D and E). Table V.25 also indicates the abnormally high capital/land ratios for both types of farms.

On the heavily capitalized farms, investment was expended mainly on trucks and cars, which were also used for non-farm activities. However, because it was difficult to attribute the farm share of these vehicles, farm capital was overstated.

The lumpiness of capital and the small size of the farms could also help to explain the low marginal value productivity of capital.

Crop and Livestock Systems

As was outlined previously, agriculture in Antigua was based essentially on sugar cane monoculture from 1674 to 1972. After 1900 cotton was successfully introduced and became the second most important crop. However, with the decline of the sugar industry in 1972 small farmers became the main agricultural producers, specializing in vegetable and root crop production. In 1984, an average of five crops per farm was cultivated on part-time farms, while the average for full-time farms was six crops per farm.

The specialization in vegetable production involves much risk. Because of the perishable nature of the crop and the lack of storage facilities, spoilage can be quite high

if the crop is not marketed in a reasonable time. Insufficient moisture is another factor which frequently affects production.

Livestock enterprises were engaged in by 34.4% of part-time and 35.7% of full-time farms. One would have expected a much higher incidence of livestock enterprises on full-time farms than on part-time farms. The main type of livestock reared on both types of farms was cattle. As a result of the low occurrence of crop-animal enterprises, particularly on full-time farms, advantage cannot be taken of the efficiency and productivity that would be derived from the close interaction of animals and crops, which is evident on small farms in Asia (Harwood, 1979). This is another reason which can be advanced for the low productivity of resources on Antiguan farms.

E. Limitations of the Study

The major focus of this study is the measurement of resource productivity of small farmers in Antigua using production function analysis. In the derivation of production functions from farm data a number of problems arise. Some of these problems involve the aggregation of outputs and inputs, the difficulty of taking management into account and the impossibility of obtaining a production function for the sample of farms which indicate the exact relationship for a single farm.[3] It is also argued that

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[3] J.W. Clarke, "The Production Function in Farm Management Research", Canadian Journal of Agricultural Economics, Vol.

given the complex and dynamic nature of a farm system, any representation of such a system by a single equation will probably not be operationally meaningful.''

Another drawback arises from the use of data for a single period. As Russell and Young (1983) noted, because resource allocation decisions are based on projections and expectations over several production periods, estimates derived from a single period may give misleading results. Estimates derived from a single period may also limit the value of policy prescriptions, if the period upon which the prescriptions are based was atypical. The serious drought conditions that prevailed during the survey period of this study were abnormal, consequently the scope of any policy prescriptions could be limited.

A comment on the quality of the data is also appropriate since primary survey data for small farms are limited by their lack of precision. While the biographic and pyhsical data can be relied upon with some degree of confidence; the economic data for the variables used in the production function analysis are less reliable, since the respondents relied solely on memory. Consequently, the data for these variables are subject to enumeration error. However, if we assume no systematic bias in the enumeration error or similar bias for both types of farms, then the general direction of the comparative results is tenable.

''(cont'd) 2, No. 2, 1954.
''Martin Upton, "The Unproductive Production Function", Journal of Agricultural Economics, Vol. XXX, No. 2, May 1979.

Despite the problems and limitations associated with data and production function analysis, the techniques remain valuable tools in farm management research methodology. Moreover, the parameters estimated using production function analysis, notwithstanding the inherent problems and limitations, can serve as indicators for policy prescriptions.

VI. Summary and Policy Implications

A. Summary of the Results

The development of part-time farming and the efficiency of resource use of part-time and full-time farms were investigated in this study. Using a random sample of farms selected from a list of all farmers occupying government owned land, the efficiency of resource use of part-time and full-time farms was estimated using a Cobb-Douglas production function.

A high degree of similarity was observed both in the personal characteristics of part-time and full-time farmers and in their farming systems.

In the comparison of operators the following findings were recorded:

(1) The majority of farmers in both groups were males, with the representation for part-time operators being 90.6% compared to 75% for full-time operators.

(2) Part-time operators were slightly older than full-time operators, with the mean age of the former being 56.9 years compared to 55.5 years for the latter. The modal ages were 48 years and 63 years for part-time and full-time operators respectively.

(3) The percentage of part-time operators who were married was 65.6 compared to 42.1 for full-time operators.

(4) Every member of both groups had some type of formal

education, with the most common educational level completed being the primary level.

(5) The modal number of dependents was 4-6 for both groups.

(6) None of the part-time operators resided on their farms compared to 14.3% for full-time operators.

(7) Off-farm employment was engaged in by 87.5% of part-time operators compared to 10.8% for full-time operators. Income was cited by the majority of both groups as the reason for working off-farm.

(8) Full-time operators spent 41-50 hours per week on the farm compared to 11-20 hours per week for part-time operators.

In the farm comparison the following findings were recorded:

(1) The majority of farms in both groups consisted of one parcel. The mean size and occupancy of the parcels were 3.19 acres and 12.6 years respectively for part-time farms, and 4.75 acres and 13.6 years respectively for full-time farms.

(2) The majority of farms were located within two miles of the farmers' homes. Walking was the most common means of travel to the farm and the majority of farmers took 11-20 minutes.

(3) For the majority of farms the distance from a paved road was between 1-100 yards.

(4) There was a general lack of equipment, machinery and

buildings on the majority of farms.

(5) Very little use was made of debt financing on both groups of farms.

(6) Livestock enterprises were engaged in by 34.4% of part-time compared to 35.7% of full-time farms.

(7) Specialization in crop enterprises, in particular vegetable production, was the norm.

(8) On part-time farms 12.4% of the land was unused compared to 10.8% for full-time farms.

(9) The majority of farms used the traditional method of hawking and vending to market their produce.

The analysis of resource productivity showed that resources were inefficiently used by both groups of farms. However, full-time farms were closer to optimum resource allocation in their use of land and labour.

B. Policy Implications

The fourth objective for this research is the proposal of policies, to improve the performance of small farmers in achieving national agricultural development objectives. The two objectives of agricultural development of Antigua are agricultural food self-sufficiency and the alleviation of rural poverty. The policy implications arising from this research which address these two objectives lie in land use, credit and capital, labour and production systems.

Land Use

The data indicate that improvement in productivity could be effected through the establishment of larger farms. In 1978 Government ownership was estimated at 70% of the total agricultural land. This ownership should facilitate a policy of farm enlargement.

With the enlargement of farms, credit-assisted capital development in the form of land improvements would become necessary. While both types of farms should be enlarged, the greater land productivity of part-time farms (part-time farms were almost 9 times more productive than full-time farms) suggests that more emphasis should be put on the expansion of these farms. Another positive feature of part-time farming is the potential to bring income into farming from other sources. The emphasis on full-time farms on the other hand should be on technological advancement, given the apparent opportunity to enhance the output of these farms through technology.

Government should also consider the establishment of a land improvement fund to develop agricultural lands. Such problems as levelling, terracing, irrigation and soil improvement could be addressed. Part of the revenue to establish this fund could come from an increase in land rent to closer match the marginal value product of the land.

Credit and Capital

Capital equipment was confined to hand tools and sprayers and simple buildings on the majority of both part-time and full-time farms. This situation derived not only from farmers' unwillingness to invest, but from the difficulty of obtaining loans from lending institutions; since loans must be secured with land and/or buildings which the majority of farmers do not own. Government could consider making changes in the present tenure system which would allow farmers to use their farms as collateral, or alternatively the security conditions for loans could be altered to improve access to credit.

Labour

The data indicate that there was excess labour on both types of farms. This finding implies that more labour intensive technology should be used. To alleviate the poverty faced by the majority of farmers, as evidenced by the low returns cited earlier, it is also essential that the marginal value productivity of labour be increased. This could be accomplished by increasing the use of land and capital. While government has direct control over the former, the latter would require a revision in credit policies and thus the necessity of the participation and support of lending institutions.

Production Systems

To reduce some of the risk involved in the specialization of vegetable production, steps should be taken to address the water problem. A part of this effort could include various water conserving practises such as mulching which ultimately ends up as organic matter in the soil and improves water holding capacity of soils. Consideration should also be given to the introduction of more livestock on all farms. The benefits from this diversification would include not only the stabilization of farm incomes, since animals can be a source of income in the event of crop failure, but also the utilization of crop residues and the recycling of nutrients into the soil.

A. Concluding Statement

Although tourism has supplanted agriculture in Antigua in terms of contribution to the economy, the latter can still play an important role in the overall development of the society. To do this however, government will have to put more emphasis on the agricultural sector. In that regard, more land should be distributed to farmers. While the political issues for the lack of redistribution are unexplored in this study, there is strong evidence that redistribution of the land in larger parcels would increase productivity. However, a caveat in any redistributive scheme should be that the land be given to proven farmers, or to individuals who are seriously committed to farming.

To facilitate agricultural development, improvements will also be necessary in such support services as marketing and credit. Regarding the former, the Central Marketing Corporation should consider expanding its handling capabilities so that more produce can be obtained from farmers to improve the dependability of supply to the hotel and restaurant trade. The system of grading should be stregthened to assure quality. Premium prices for quality products at the farm gate could be used as incentives. Steps should be taken to make credit more accessible to the majority of small farmers.

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Appendix A

Questionnaire No. _____

Stratum _____

Name _____

Photo Nos. _____

Date of Interview _____

Survey of Smallholders in Antigua
Faculty of Agriculture and Forestry
University of Alberta

A. Introduction

1. Name of farm operator: _____
2. Do you live on the farm? Yes _____ No _____
3. Place of Residence (parish and village): _____
4. Do you have off-farm employment? Yes _____ No _____
   If yes:
   a. What is your main off-farm employment? _____
5. Which factor is most important in the selection of your main off-farm occupation? (check one)
   a. _____ Income
   b. _____ Time
   c. _____ Prestige
6. How many hours per week do you work in your main off-farm employment? _____ hrs.
7. How many hours per week do you work on your land during:
   a. sowing season _____ hrs.
   b. growing season _____ hrs.
   c. harvest season _____ hrs.
8. Was this work done mainly:
   a. _____ during the evening and/or weekend
   b. _____ during the morning and/or weekend
   c. _____ weekend only

B. General Characteristics of Farm

1. How many parcels of land do you farm? _____ parcels

Parcel No:	1	2	3	4	5	6	Other
Land Description:							
Total Size (acres)							
Cropped (acres)							
Fallow (acres)							
Pasture (acres)							
Unused (acres)							
Trees (acres)							
Topo. Description (%):							
Bottom (%)							
Hillside (%)							
Upland (%)							
Soil Class:							
Tenure:							
Owned							
Leased							
Rented							
Shared							
Absentee landlord (Y/N)							
Years Farmed by Operator:							
Distance From Home (mls.):							
Means of Travel:							
Time to Plot from home (mins.):							
Distance From Paved Road (yds.):							

C. Farm Household Data

1. Age of farm operator: _____ yrs.
2. Sex of farm operator: ____ Male ____ Female
3. Years in farming on own: _____ yrs.
4. Present marital status:

   a. ____ married
   b. ____ single
   c. ____ divorced
   d. ____ separated
   e. ____ widowed

5. What is the highest level of schooling you have completed?

   a. ____ no schooling
   b. ____ elementary
   c. ____ primary
   d. ____ secondary
   e. ____ university

6. How many children do you have? _____
7. How many presently live at home? _____
8. How many non-family members work on the farm? _____
9. Do you have any permanent health or disability problems which affect farming operation?
   Yes ____ No ____
10. Profile of family members who live at home (relatives included):

Relationship	Age	Sex	Highest Level of Formal Education Completed	Occupation

D. Production Data

1. Staple Crops:	Home Consumption (lbs.)	% Marketed	Value Sold ($)
2. Vegetables:			
3. Fruits:			
4. Cash Crops:			

5. Livestock	No. Owned (last 12 mo.)	No. Consumed at Home (last 12 mo.)	Sold (last 12 mo.)	Value ($) of Sales (last 12 mo.)
Dairy Cattle				
Beef Cattle				
Sheep				
Goats				
Pigs				
Chickens				

E. Labour Disposition on the Farm (person day/month) One person day equals 8 hours for people 15-65 years.

	MONTH											
Activity:	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Tillage, Seeding, Weeding												
Buy, Sell, Managing, Repairing												
Harvesting, Storing												
Livestock												
SUB-TOTAL												
Non-family Paid Labour												
TOTAL FARM LABOUR												
School/ Housekeeping												
Off-farm Work												
Time Off/ No Work												
TOTAL												
Available Net Family Labour												

F. Farm Equipment and Buildings

1. Machinery:

	Purchase Price ($)	Year Purchased	Value ($)
Tractor (hp _____)			
Plow			
Truck			
Car (farm use ____%)			
Sprayer			
Irrigation Equipment			
Other			

2. Tools:

	Number	Value ($)
Machette		
Hoe		
Fork		
Wheel Barrow		
Other		

3. Buildings:

	Cost ($)	Days Labour	Year Built	Value ($)
Sheds				
Store Room				
Pens				
Other				

G. Land Improvements

	Cost ($)	Days Labour	Value ($)
Drains			
Terracing			
Irrigation			
Leveling			

Fencing _____ _____ _____

Other _____ _____ _____

H. Other Inputs (last 12 months)

	Type Used	Cost ($)
Fertilizer		
Insecticide		
Fungicide		
Herbicide		
Seed		
Fuel/oil		
Interest		

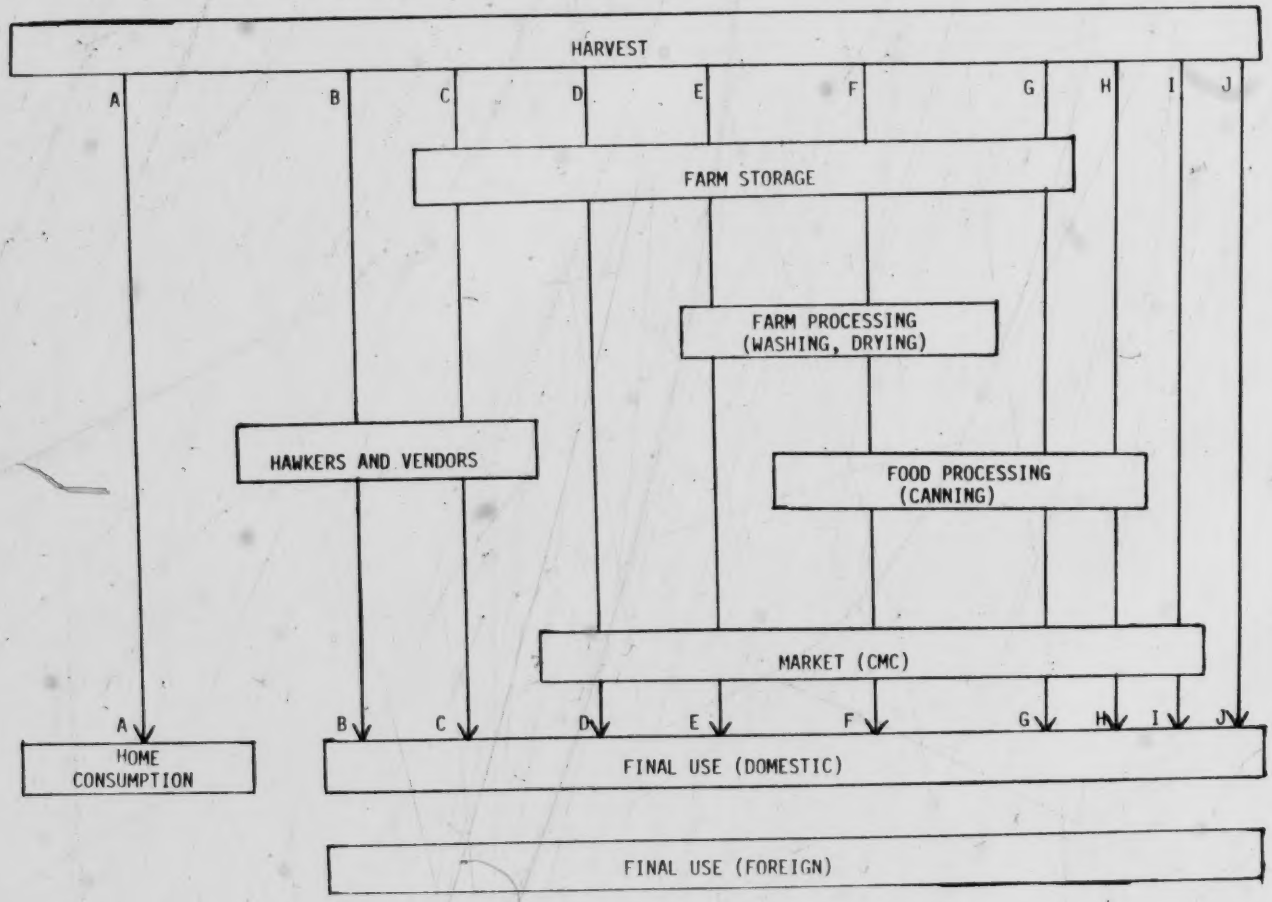
I. Cropping System

Cropping Pattern	Months Planted	Months Harvested	Months Consumed	Planting Arrangement	Proportion Inter cropped	Water Source	Area Harvested

J. Finance

1. Do you borrow to finance farming? _____ Yes _____ No
2. Which of the following is the credit used to finance?
   a. _____ Land
   b. _____ Machinery
   c. _____ Livestock
   d. _____ Construction and repairs
   e. _____ Home consumption
   f. _____ Special events
3. Through what sources do you obtain credit?
   a. _____ Commercial Banks
   b. _____ Antigua and Barbuda Development Bank
   c. _____ Friend/Relative
   d. _____ Farmers Association
4. In round figures what is your total farm and personal debt today? $ _____
5. What percentage of the debt is for farming? _____%

POST PRODUCTION SYSTEM FOR STAPLE CROPS



Appendix B

Production of Selected Agricultural Products by Small Farmers 1979 - 1982 (Metric ton).

Products	1979	1980	1981	1982
Banana	88.96	82.80	171.95	230.88
Sweet Potato	60.24	65.73	118.77	222.15
Yams	61.61	3.37	24.20	69.90
Eddoes	14.39	9.80	12.06	23.62
Cassava	24.07	11.64	26.56	74.12
Maize	29.70	22.22	32.90	65.33
Tomatoes	52.23	29.17	41.48	187.01
Cabbage	42.46	61.21	80.74	192.52
Cucumber	45.65	38.32	46.74	150.88
Carrots	28.20	27.10	40.29	117.37
Sweet Pepper	10.45	15.34	20.62	51.29
Okra	12.37	18.24	17.85	34.49
Beans	14.42	14.81	21.06	84.96
Egg Plant	22.75	44.72	47.15	150.60
Melons	9.04	13.11	21.71	51.40
Squash	15.15	27.57	31.91	118.31
Pumpkin	23.87	16.76	31.82	148.57
Hot Pepper	-	-	5.40	11.88
Peanuts	-	-	2.60	5.50
Beet	10.00	14.27	9.03	18.98
Onions	11.95	6.04	7.73	29.05

Source: Central Marketing Corporation, Antigua.

Appendix C

Sugar Production of Antigua (1698 - 1971).

Year	Tons	Year	Tons	Year	Tons
1698	2,242	1723	6,064	1741	6,683
1699	4.075	1724	6,784	1742	4,611
1700	2,639	1725	1,979	1743	7,303
1701	2,549	1726	5,705	1744	6,389
1702	2,912	1728	5,658	1745	6,160
1703	3,889	1729	2,147	1746	7,188
1704	2,247	1730	3,953	1747	3,104
1706	872	1731	7,468	1748	8,902
1707	4,530	1732	5,968	1749	8,767
1708	2,228	1733	7,471	1750	6,823
1709	3,243	1726	3,882	1751	6,564
1710	5,626	1728	9,362	1752	5,898
1711	2,384	1729	10,276	1753	12,457
1712	3,025	1730	9,114	1754	3,158
1713	6,460	1731	6,221	1755	10,465
1714	4,368	1732	6,533	1756	8,840
1715	5,473	1733	9,413	1757	11,238
1716	6,064	1734	4,233	1758	11,373
1717	6,784	1735	9,202	1759	5,147
1718	1,979	1736	7,455	1760	5,343
1719	5,705	1737	1,732	1761	9,698
1720	5,685	1738	7,320	1762	8,383
1721	2,147	1739	9,688	1763	6,398
1722	3,953	1740	5,372	1764	9,650

Appendix C (Cont'd)

Year	Tons	Year	Tons	Year	Tons
1765	4,585	1817	8,737	1841	14,443
1766	12,450	1818	11,170	1842	7,370
1767	12,513	1819	10,063	1843	8,670
1768	10,399	1820	7,842	1844	11,255
1769	6,762	1821	10,062	1845	10,500
1770	11,323	1822	5,005	1846	5,132
1771	5,608	1823	6,536	1847	12,012
1772	5,711	1824	10,788	1848	8,094
1773	4,044	1825	6,870	1849	9,449
1774	11,672	1826	11,838	1850	6,193
1775	12,580	1827	3,619	1851	10,011
1776	9,848	1828	8,592	1852	9,283
1777	4,317	1829	7,572	1853	10,120
1778	5,447	1830	7,931	1854	12,255
1779	2,534	1831	9,658	1855	10,992
1780	1,783	1832	7,166	1856	10,199
1792	3,676	1833	6,547	1857	10,190
1800	5,882	1834	12,858	1858	11,922
1807	6,540	1835	8,740	1859	9,835
1809	4,992	1836	6,748	1860	9,279
1810	9,012	1837	3,108	1861	8,182
1814	6,982	1838	10,152	1862	12,920
1815	7,459	1839	11,154	1863	10,124
1816	9,634	1840	10,153	1864	2,618

Appendix C (Cont'd)

Year	Tons	Year	Tons	Year	Tons
1865	7,906	1889	14,423	1913	7,145
1866	13,840	1890	16,120	1914	15,345
1867	5,641	1891	12,091	1915	11,320
1868	11,400	1892	15,302	1916	18,542
1869	9,406	1893	14,562	1917	17,046
1870	11,400	1894	1,234	1918	9,409
1871	11,900	1895	6,685	1919	12,481
1872	6,500	1896	13,744	1920	15,540
1873	8,700	1897	12,766	1921	9,365
1874	5,500	1898	6,968	1922	7,703
1875	13,300	1899	10,084	1923	11,395
1876	7,500	1900	7,622	1924	16,400
1877	9,100	1901	9,125	1925	17,300
1878	9,200	1902	12,611	1926	12,800
1879	9,200	1903	10,494	1927	23,301
1880	9,500	1904	13,904	1928	19,811
1881	8,645	1905	7,829	1929	10,945
1882	12,769	1906	13,328	1930	18,257
1883	10,518	1907	10,806	1931	5,202
1884	13,721	1908	13,451	1932	19,230
1885	11,848	1909	12,075	1933	23,875
1886	12,271	1910	18,145	1934	20,667
1887	14,052	1911	17,125	1935	16,072
1888	19,925	1912	10,187	1936	20,667

Appendix C (Cont'd)

Year	Tons	Year	Tons	Year	Tons
1937	16,072	1943	16,279	1962	20,500
1938	21,260	1944	20,663	1963	27,700
1939	26,023	1945	26,023	1964	21,100
1940	17,854	1946	27,000	1965	14,000
1941	21,979	1956	26,023	1970	4,000
1942	21,867	1959	31,282	1971	11,000

Sources: Noel Deerr, The History of Sugar, Chapman and Hall Ltd., Vol.1, 1949, pp.195-196; Carleen O'Loughlin, Economic and Political Change in the Leeward and Windward Islands, Yale University Press, 1968, p.106; Caricom Statistics Yearbook 1978, Caribbean Community Secretariat, Georgetown, Guyana, p.52.

Appendix D

Observations of output, farm size, labour and capital used in production function for part-time farms, Antigua 1984.

Output (E.C. $)	Farm Size (Acres)	Labour (Person-days)	Capital (E.C. $)
4,710	9.50	128.00	28,808
0	1.00	190.22	197
22	3.00	320.00	392
400	3.00	106.67	113
1,800	3.10	174.22	184
1,770	4.50	142.22	188
120	2.00	106.67	6756
1,920	6.00	71.11	1,418
1,135	2.00	80	1,025
1,480	0.80	53.33	12,026
1,070	4.00	97.78	1,792
215	1.50	72.89	909
2,725	6.00	133.33	1,755
220	1.00	160	437
1,230	1.25	39.11	876
1,050	5.00	80	838
1,100	2.00	51.56	294
737	1.50	213.33	217
1,160	2.00	124.44	263
2,290	2.50	49.78	221

Appendix D (Cont'd)

Output (E.C. $)	Farm Size (Acres)	Labour (Person-days)	Capital (E.C. $)
4,220	5.50	80	328
115	5.50	186.67	45,221
1,425	3.80	10.67	7,530
1,549	1.70	42.67	479
1,695	5.00	186.67	985
1,500	4.00	106.67	19,535
220	2.00	85.33	201
3,762	4.00	80	1,541
1,200	1.00	106.67	982
1,500	1.75	124.44	141
33	1.16	64	144
805	5.00	106.67	658

$1.00 E.C. = $0.37 U.S.

Source: Survey Results.

Appendix E

Observations of output, farm size, labour and capital used in production function for full-time farms, Antigua 1984.

Output (E.C. $)	Farm Size (Acres)	Labour (Person-days)	Capital (E.C. $)
350	4.30	320.00	6.00
6,280	3.00	320.00	5,218
7,527	30.5	186.67	74,267
1,165	6.00	336.00	34,969
8,770	17.0	320.00	25,819
510	3.12	186.67	444
3,505	6.75	266.67	3,318
110	1.25	266.67	994
23,040	7.00	323.56	132,868
1,745	1.00	177.78	2,188
100	7.00	256.00	9,178
230	3.00	240.00	30
305	1.25	88.89	405
1,890	3.50	373.33	5,224
38	0.25	256.00	133
2,030	0.75	160.00	631
140	5.00	213.33	1,021
351	4.50	266.67	1,540
632	3.00	266.67	831
220	7.00	384.00	1,836

Appendix E (Cont'd)

Output (E.C. $)	Farm Size (Acres)	Labour (Person-days)	Capital (E.C. $)
95	4.50	373.33	6,428
5	3.14	106.67	101
25	2.20	213.33	168
125	1.50	224.00	173
175	1.00	128.00	185
175	1.50	106.67	1,035
40	2.00	133.33	80
100	2.00	80	1,338

$1.00 E.C. = $0.37 U.S.

Source: Survey Results.

Appendix F

The material on this page has been removed because of the unavailability of copyright permission. The material was a map of the Caribbean showing the location of Antigua. It was taken from page iv of the book "Change in the Commonwealth Caribbean" by Anthony Payne, published by Chatham House Papers, No. 12, London, 1981.

Appendix G

Food Imports as a Percentage of Total Imports, Antigua (E.C.$' 000) 1969-1982.

Year	Total Imports	Food Imports	Annual Increase (%)	Food as a % of Total
1969	57,183	10,243	-	17.9
1970	72,649	13,164	27.0	18.1
1971	86,767	14,645	19.4	16.9
1972	90,976	16,419	4.8	18.1
1973	94,503	14,876	-3.9	15.7
1974	143,749	21,852	52.1	15.2
1975	145,141	24,521	0.96	16.9
1976	91,836	20,891	-36.7	22.7
1977	92,887	25,273	1.14	27.2
1978	110,719	31,911	19.2	28.8
1979*	169,019	70,644	52.6	41.8
1980*	233,630	56,666	38.2	24.3
1981*	324,187	84,794	38.8	26.2

*Provisional

Source: Statistics Division, Ministry of Finance.